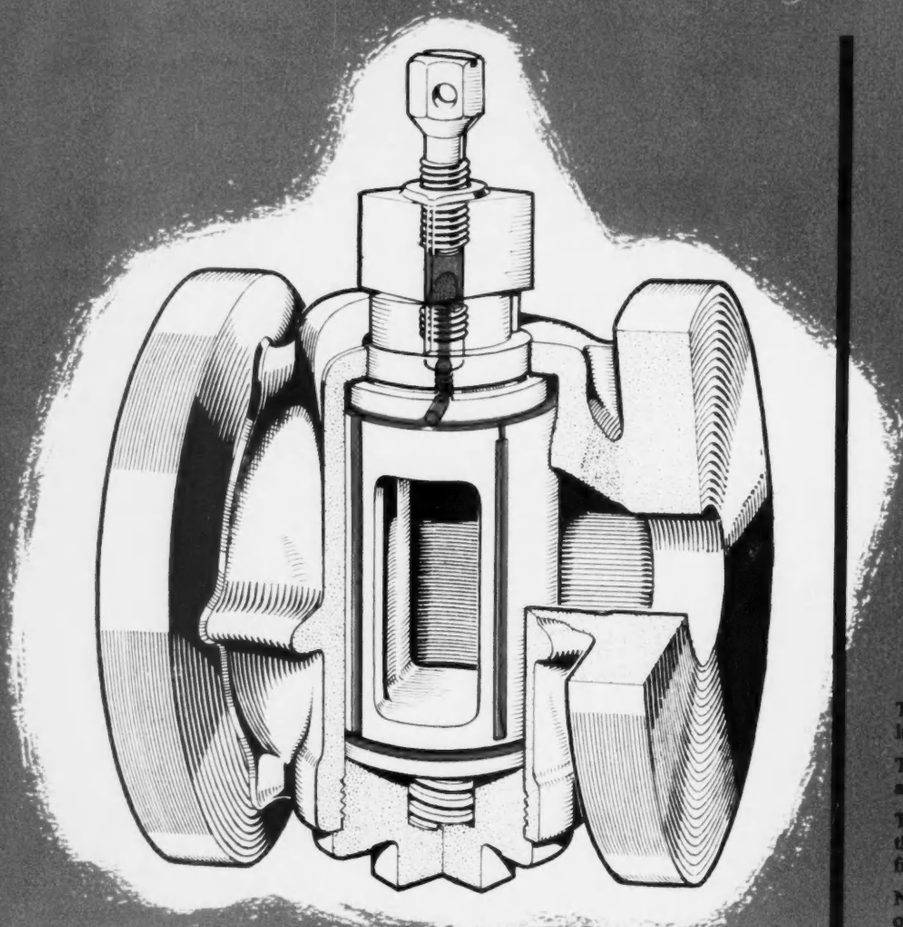
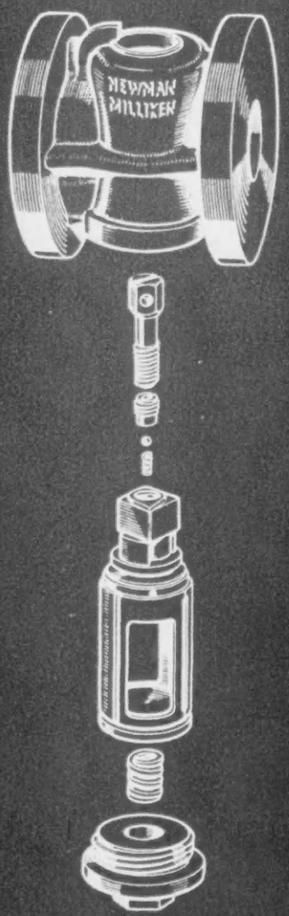
# THE ENGINEER

DECEMBER 11, 1959 | 28 ESSEX STREET, STRAND, LONDON, W.C.2 | TWO SHILLINGS



## Newman-Milliken



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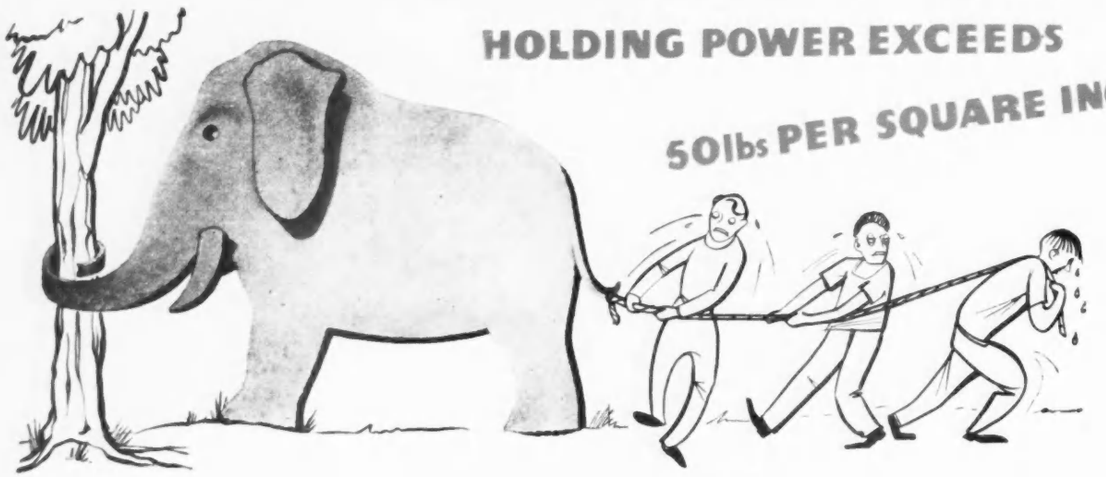

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# THE ENGINEER

*Established* 1856

No. 5420 **DECEMBER 11, 1959** VOL. 208

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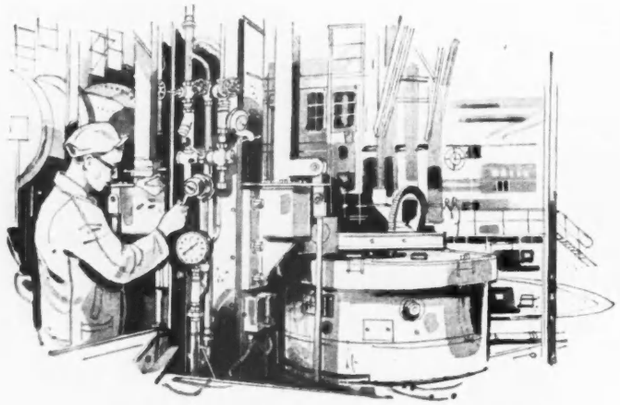

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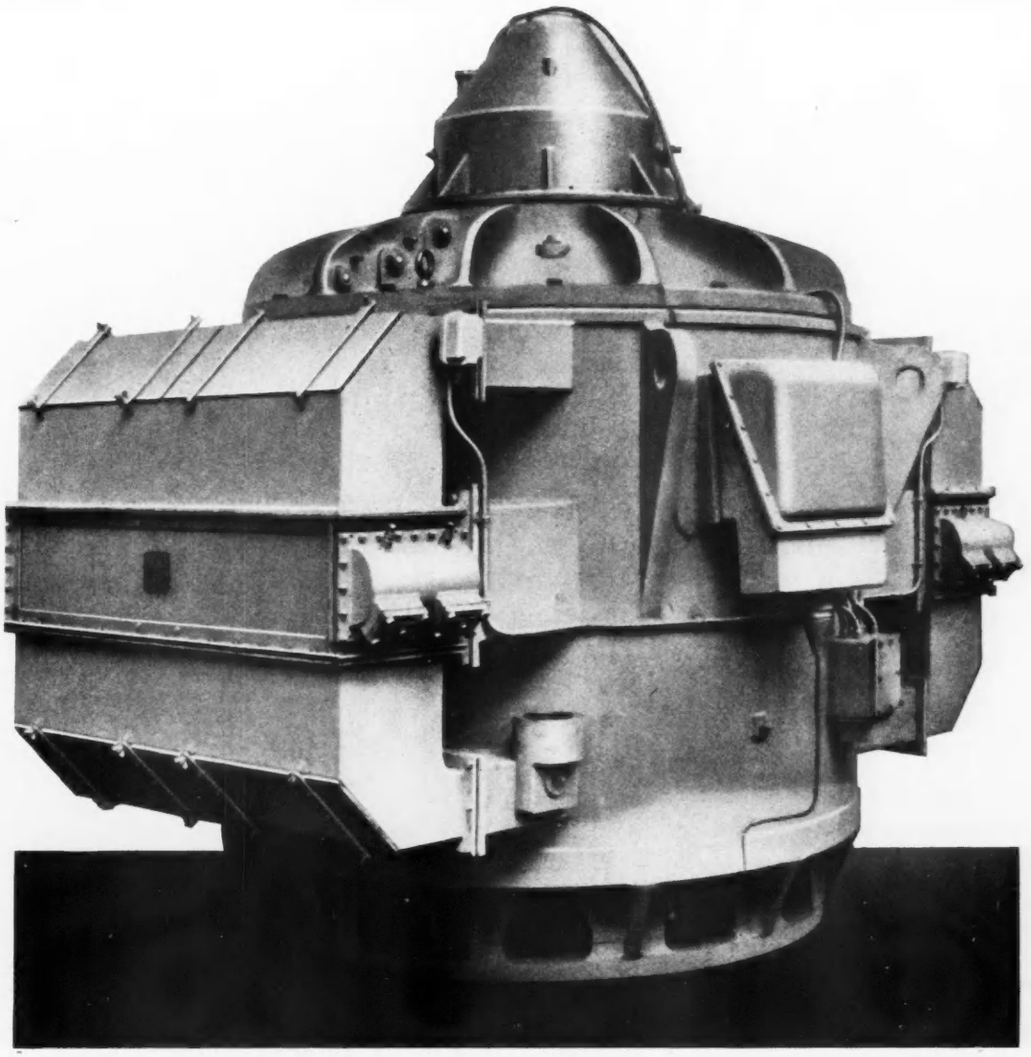

*"Trislot" motor of 1250 h.p., 595 r.p.m., for pump drive, Boundary Dam Power Station, Canada. Closed-air-circuit type with water cooler. Shaft and bearings designed to support a downwards thrust of 14 tons.*

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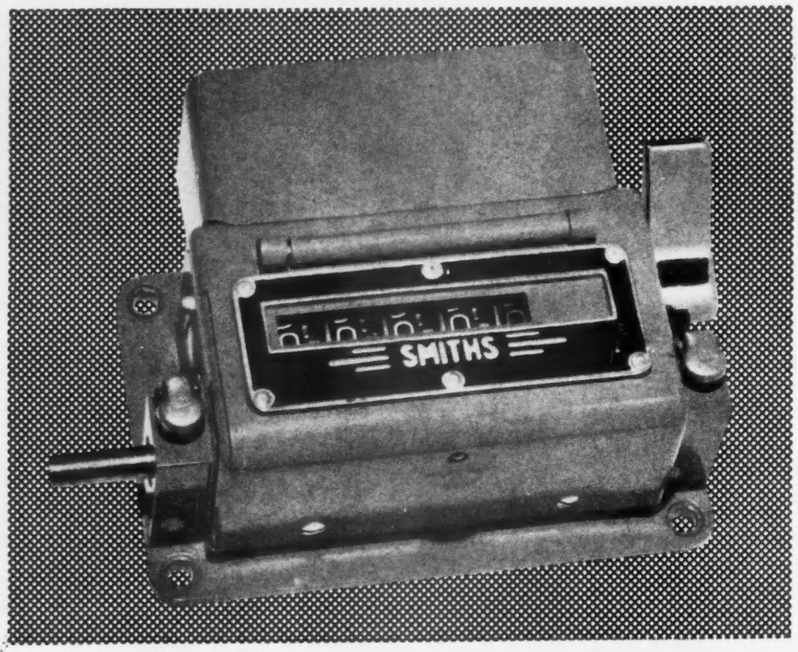


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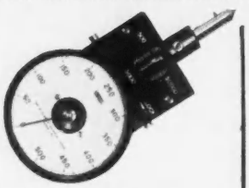

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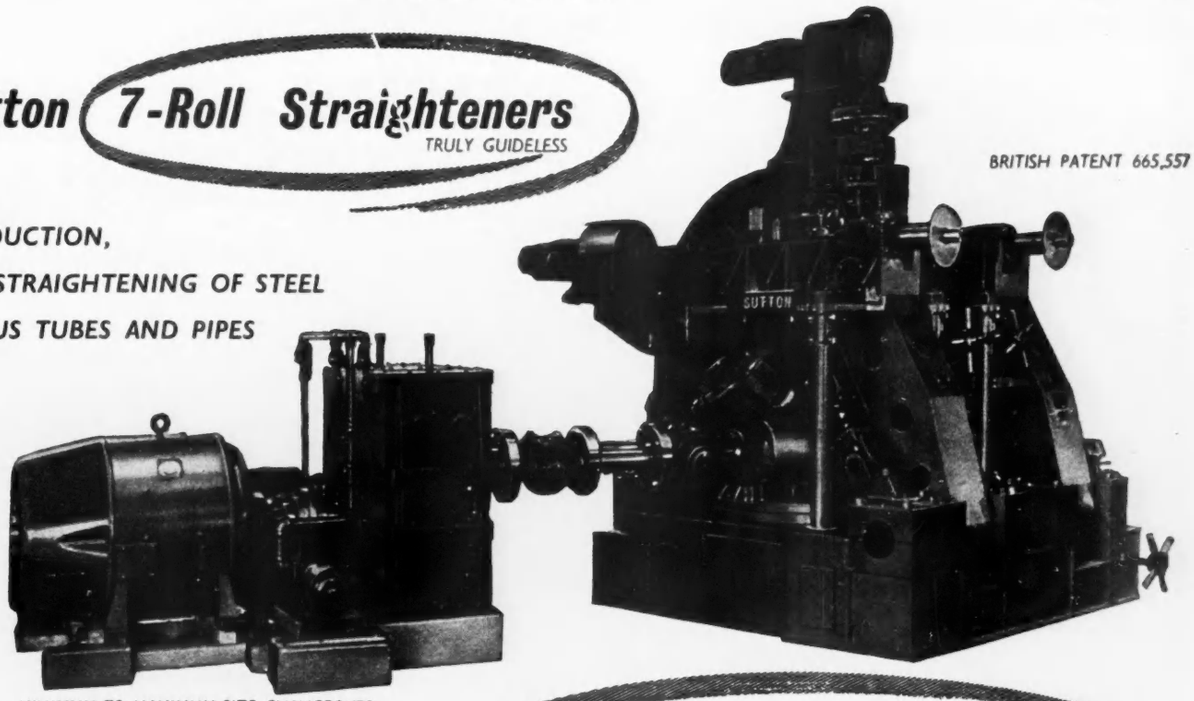


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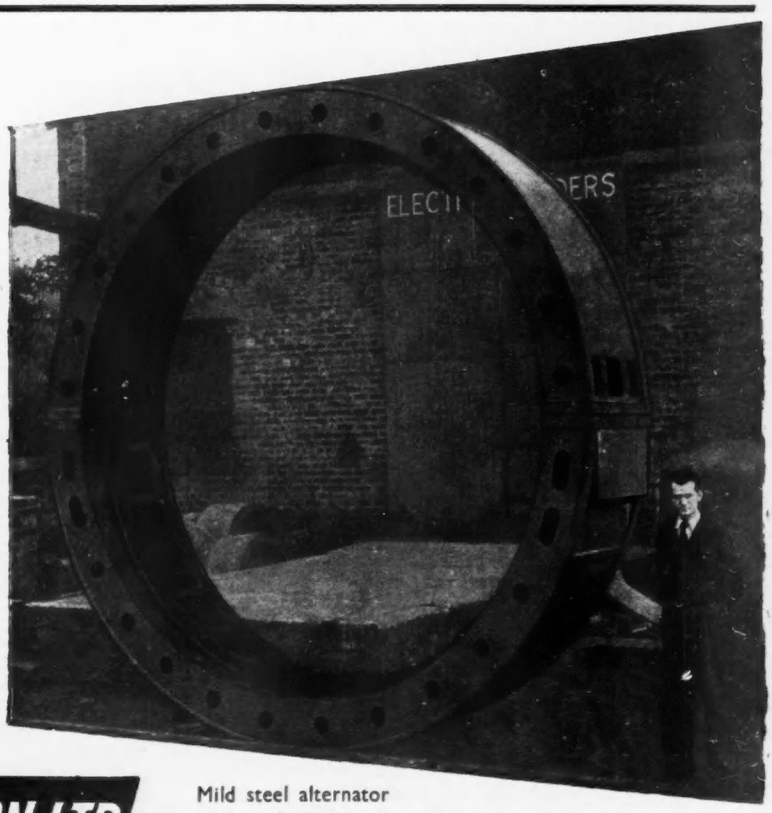

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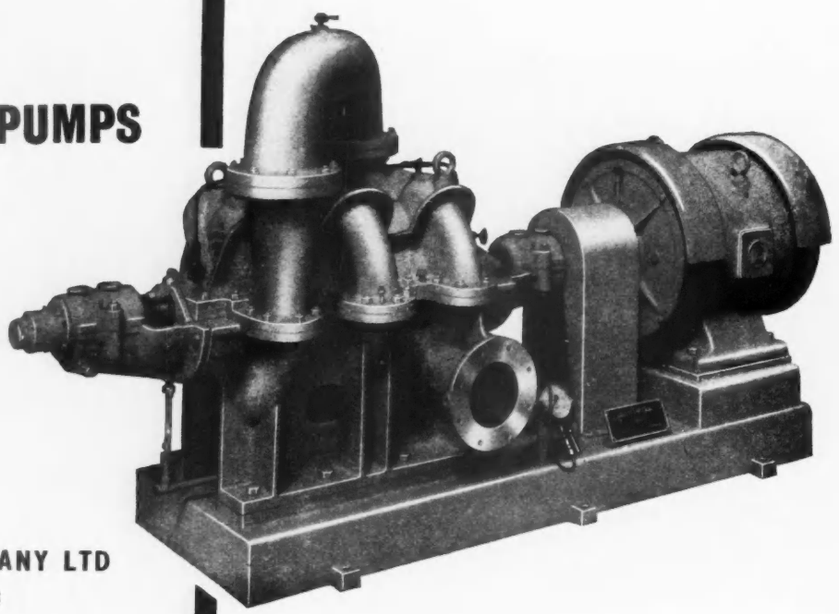

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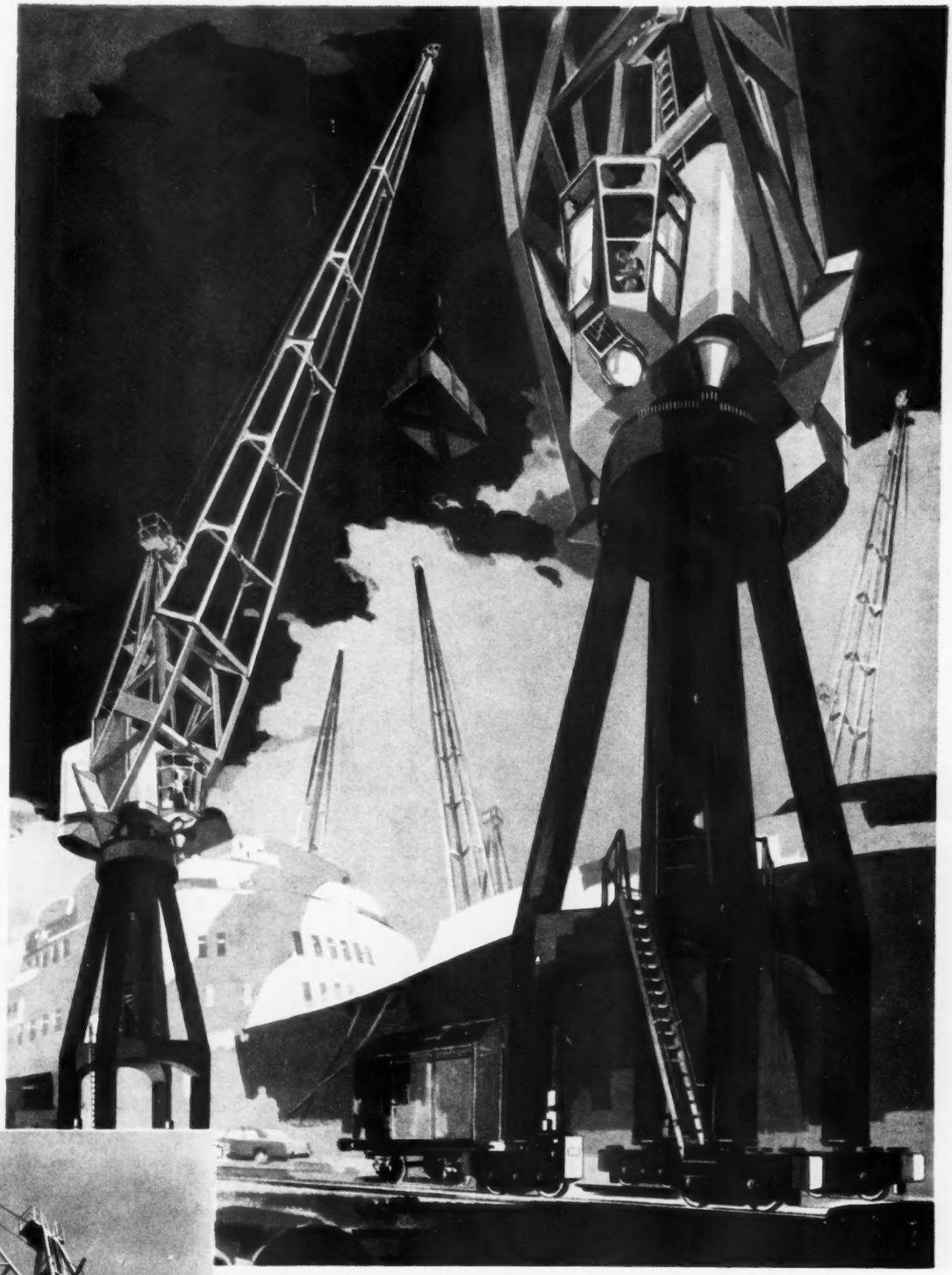

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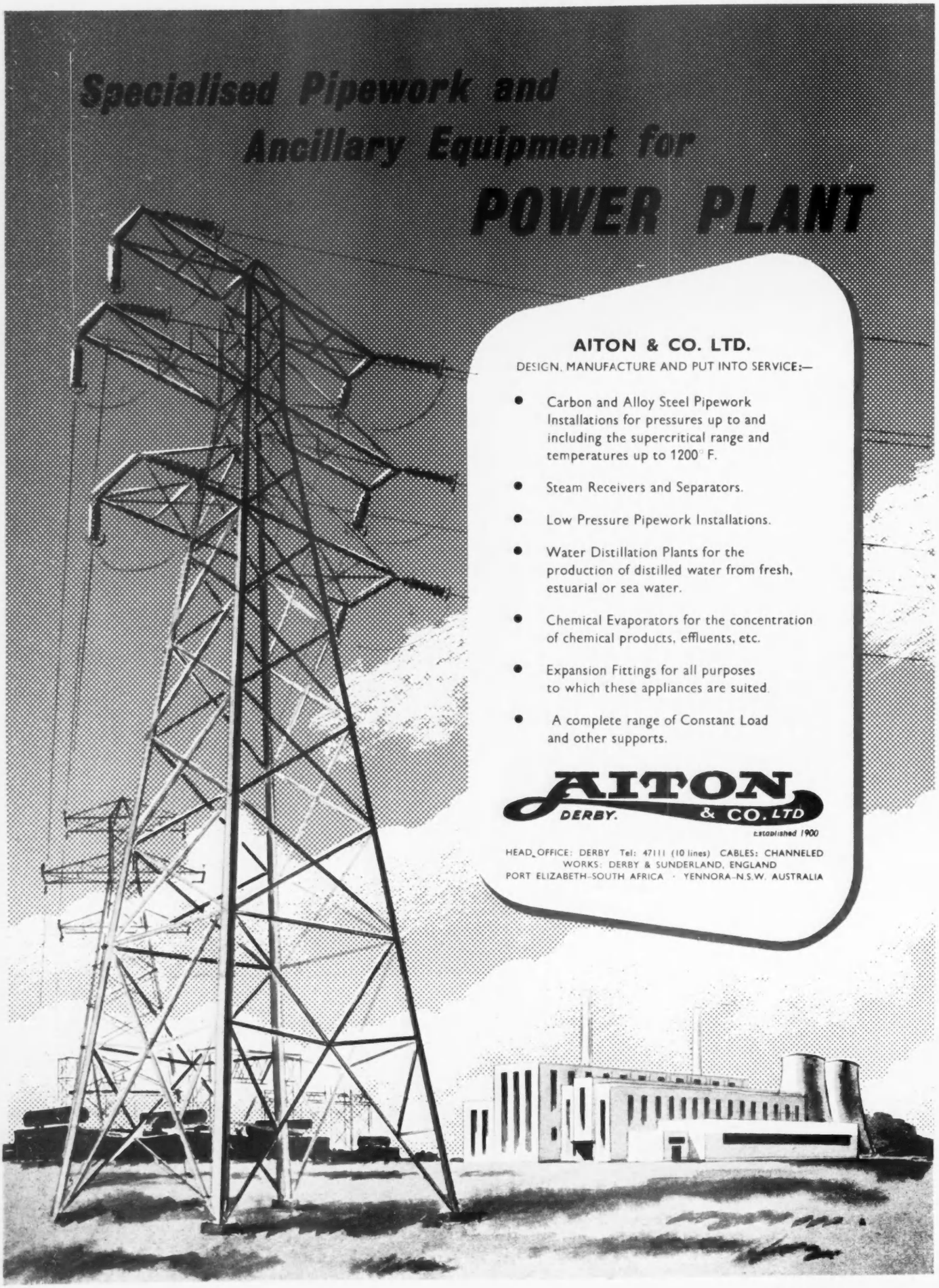
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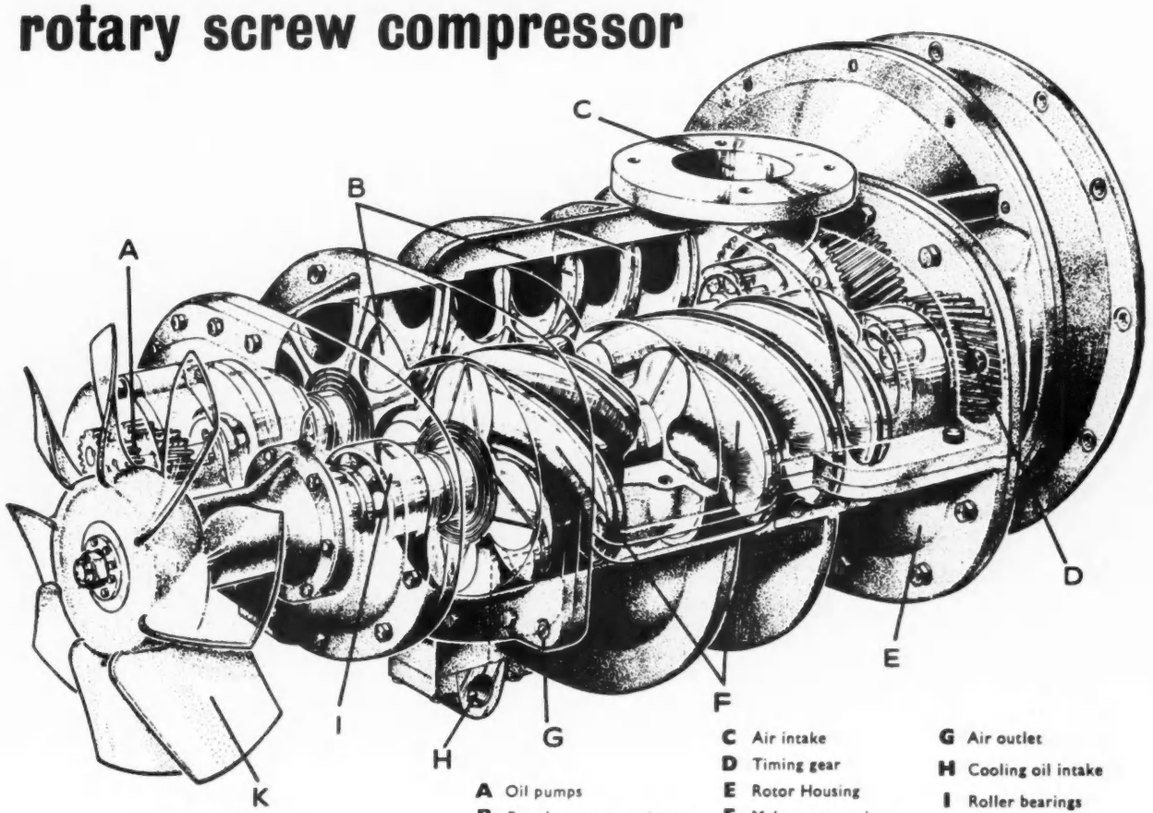


**A** Oil pumps
**B** Female rotor, primary and secondary stage
**C** Air intake
**D** Timing gear
**E** Rotor Housing
**F** Male rotor, primary and secondary stage
**G** Air outlet
**H** Cooling oil intake
**I** Roller bearings
**K** Oil-cooler fan

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*The Nasiriyah Bridge was built by Dorman Long & Co. Limited (Consulting Engineers: Rendel, Palmer & Tritton) and the Auckland Harbour Bridge was built in partnership by Cleveland Bridge & Engineering Co. Ltd. and Dorman Long & Co. Limited (Consulting Engineers: Freeman, Fox & Partners).*

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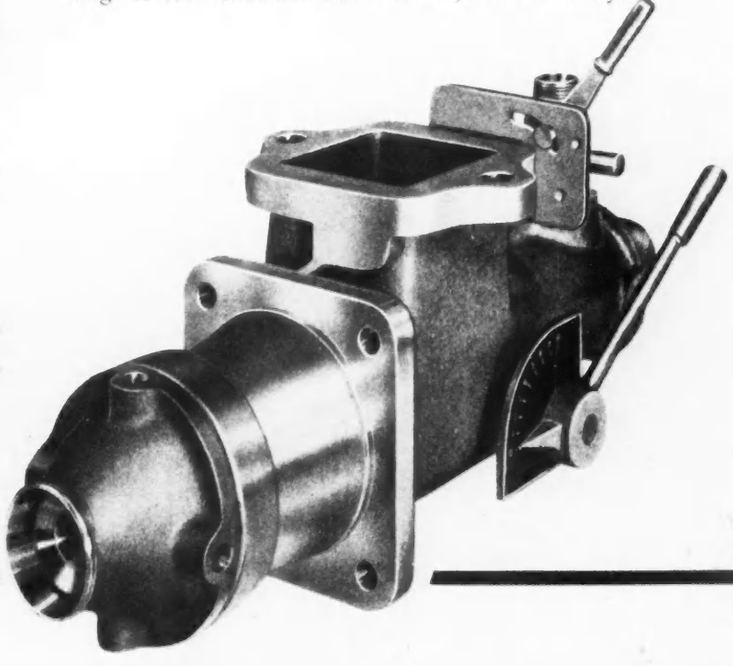

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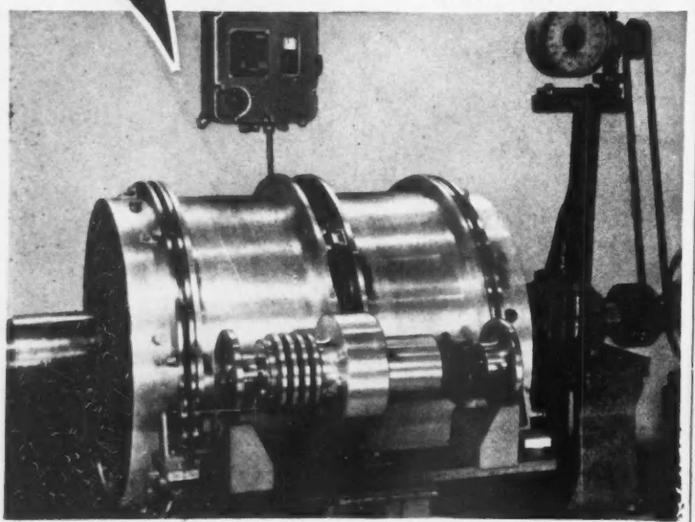

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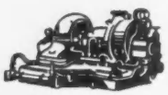

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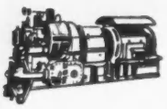

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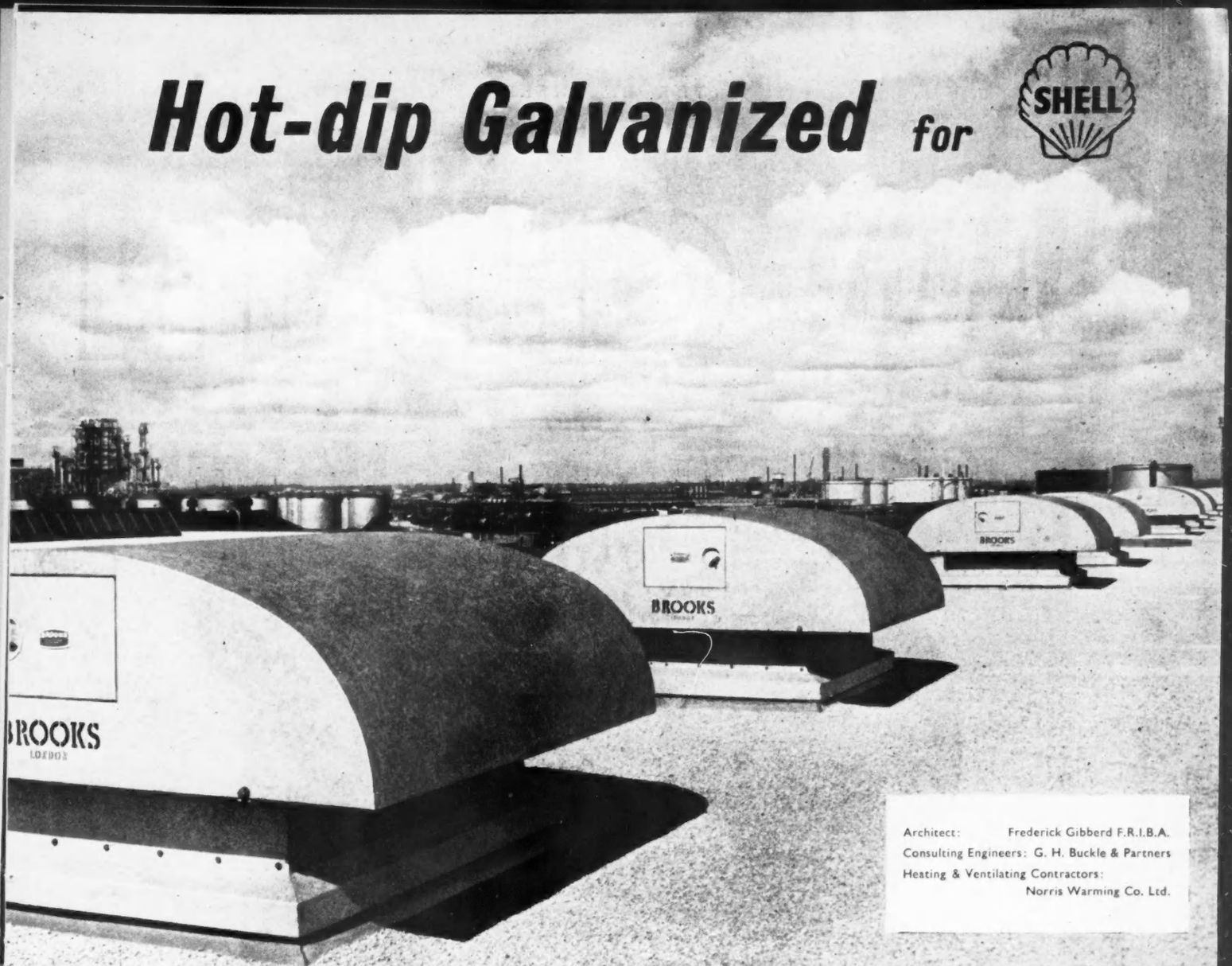


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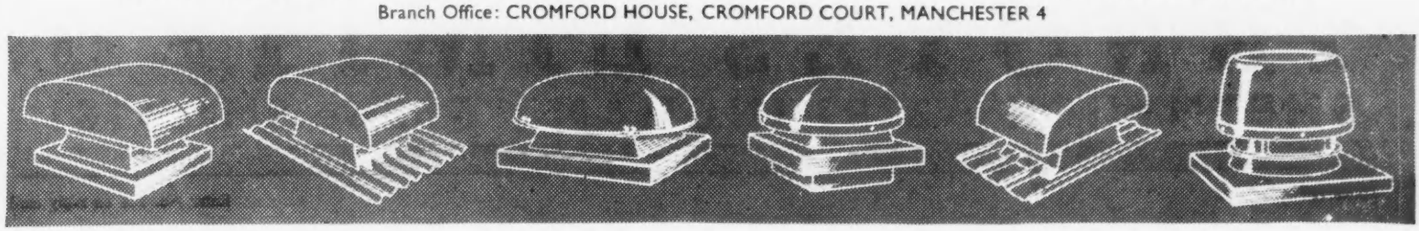

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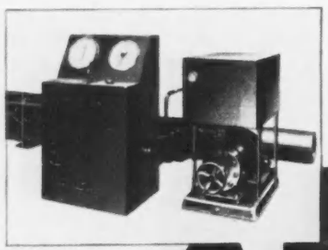
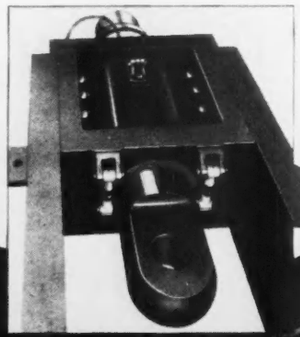
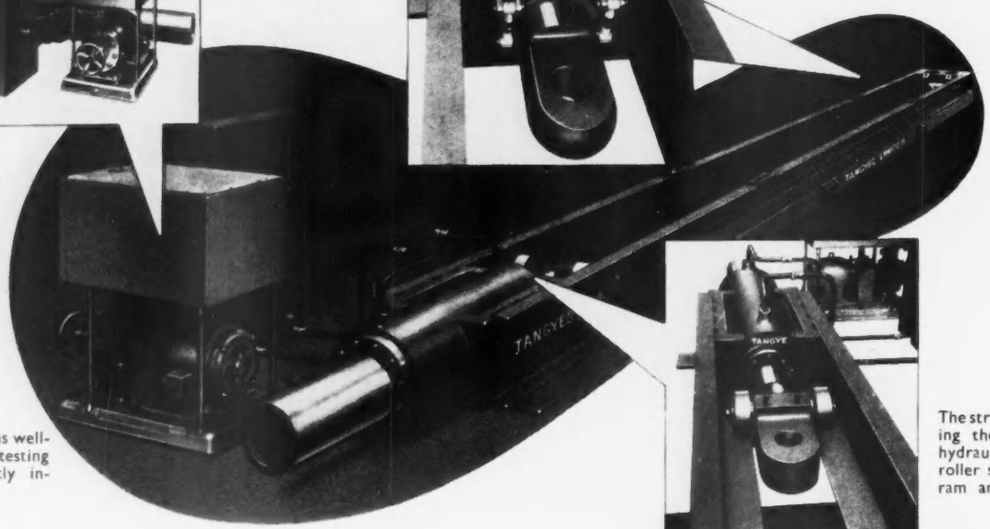
# TANGYE CHAIN TESTING MACHINES



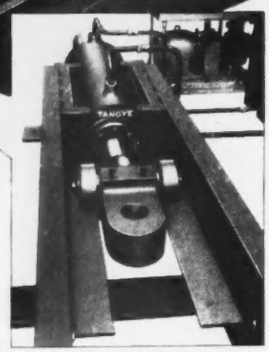
View from operating position showing control Cabinet and pump with oil reservoir.



The resistance head showing linkage support to eliminate friction. Hydraulic capsule and capillary tube also shown.



A Tangye 100 tons well-type chain testing machine recently installed.

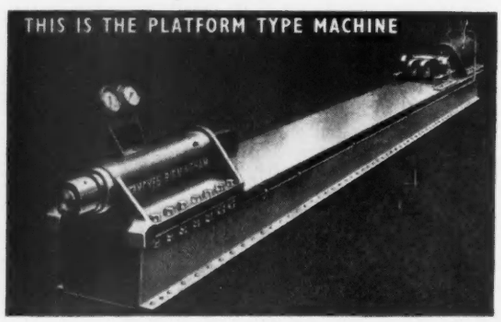


The straining end showing the double acting hydraulic cylinder and roller supports for the ram and tension rod.

*This range of machines is for testing chains, shackles, complete lifting blocks, large rings and similar gear. One of the many features of these machines is the use of a tension rod which is suspended on links to take its weight and the weight of the specimen, thus preventing the rod contacting the bore and constituting a resistance. The pull being applied during a test is registered by a sensitive load capsule located on the tension rod, the capsule in turn being connected via capillary tubing to a dial-type load indicator.*

*Two types of machine are supplied, "Platform" or "Well" types, and these can be arranged for almost any working load, stroke or length. Examples of dimensions and capacities of machines now in use are shown in the table.*

**FULL INFORMATION IS AVAILABLE ON REQUEST.**




**EXAMPLES OF CAPACITIES OF MACHINES NOW IN USE SHOWN BELOW**

| | *Platform Type* | | | | *Well Type* | | | |
|---|---|---|---|---|---|---|---|---|
| Working Load. *In Tons* ... | 50 | 75 | 75 | | 15 | 30 | 50 | 100 |
| Stroke of Straining End Piston. *In Inches* ... ... | 36 | 36 | 36 | | 30 | 30 | 30 | 36 |
| Centres of Eye Ends on Tension Rods ... ... | 30' | 34' | 16' | | 20' 6" | 30' 6" | 25' 9" | 51' |

# TANGYES LIMITED

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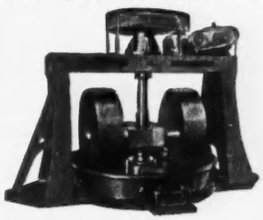

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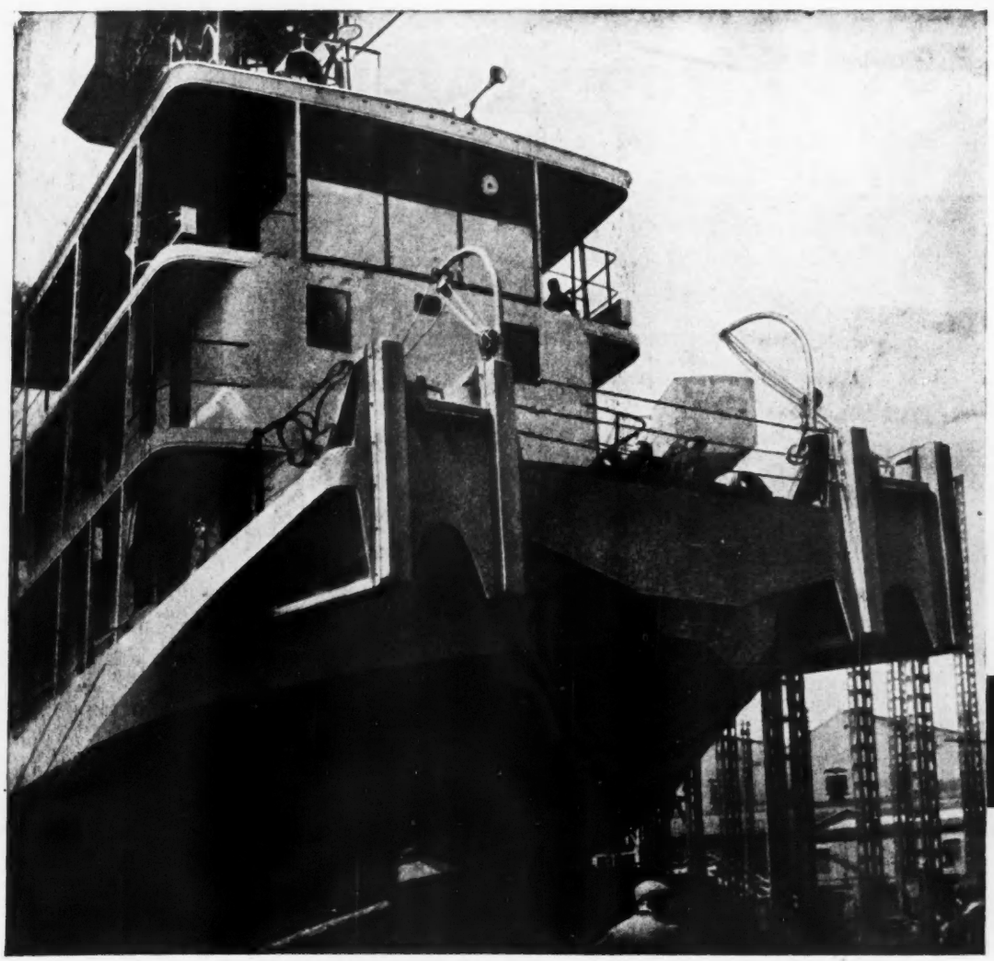

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'GONGOLA'

This Pusher Tug and a Train of eight close coupled barges was constructed by Yarrow to the order of the United Africa Company, for service on the Niger and Benue Rivers, West Africa. Overall length of the complete unit 630 feet, beam 66 feet, loaded displacement 4,650 tons.

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# Thompson

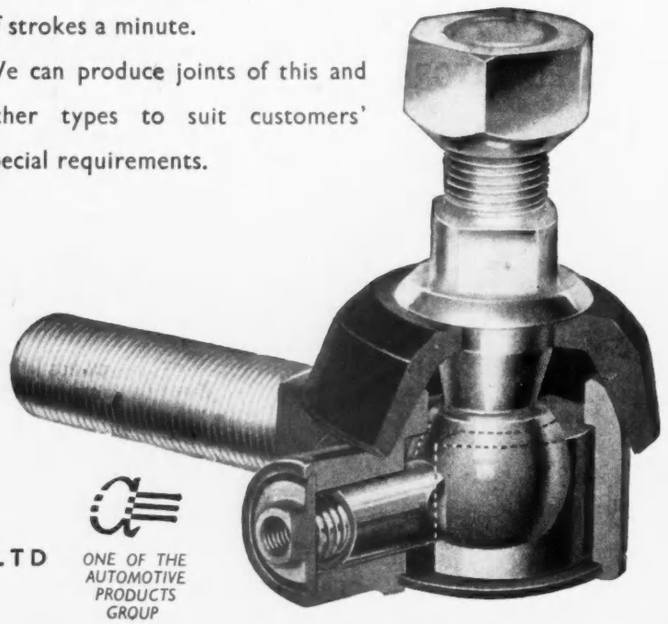
## SELF-ADJUSTING BALL-JOINTS

These joints are self-adjusting and are very well made from fine materials. Used extensively on steering connections for every class of road vehicle, they are also valuable in a great many applications in general engineering, where their use can often save specially-made joints and at the same time give an improved result by eliminating backlash.

### A SPECIAL-PURPOSE JOINT

The illustration shows a 1" eccentric-type self-adjusting joint. This forms the crank-pin and big-end bearing of a crank operating the cutter bar of a mower, at many hundreds of strokes a minute.

We can produce joints of this and other types to suit customers' special requirements.



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*and prevent atmospheric pollution in the most efficient and economical way*

● ***Dust collected in dry or wet form*** ● *Designed to meet individual applications* ● ***Valuable materials normally lost are recovered*** ● *Very low pressure drop* ● ***Used on gases at normal or high temperatures*** ● *Small temperature drop*

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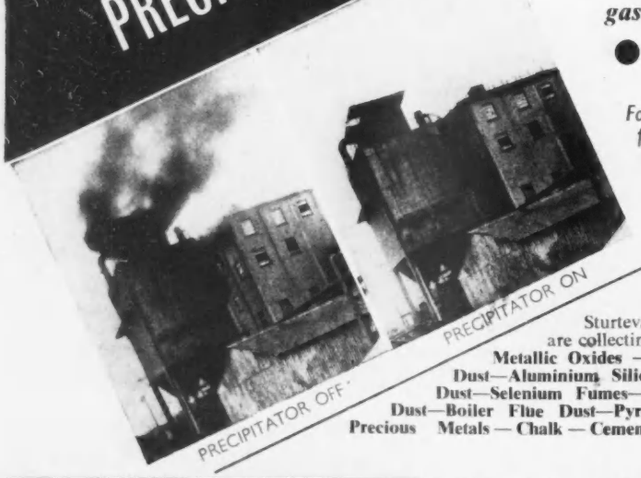


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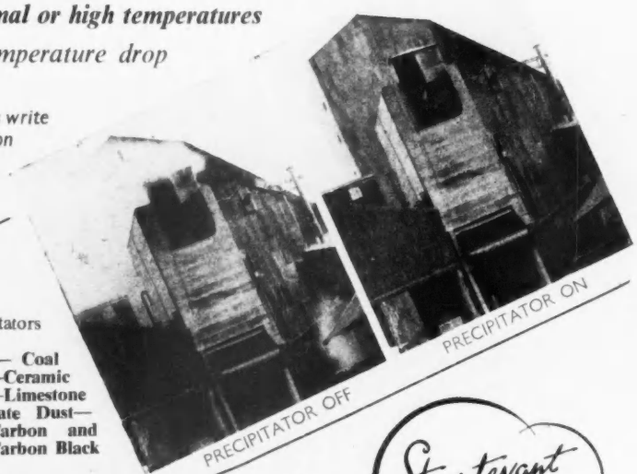


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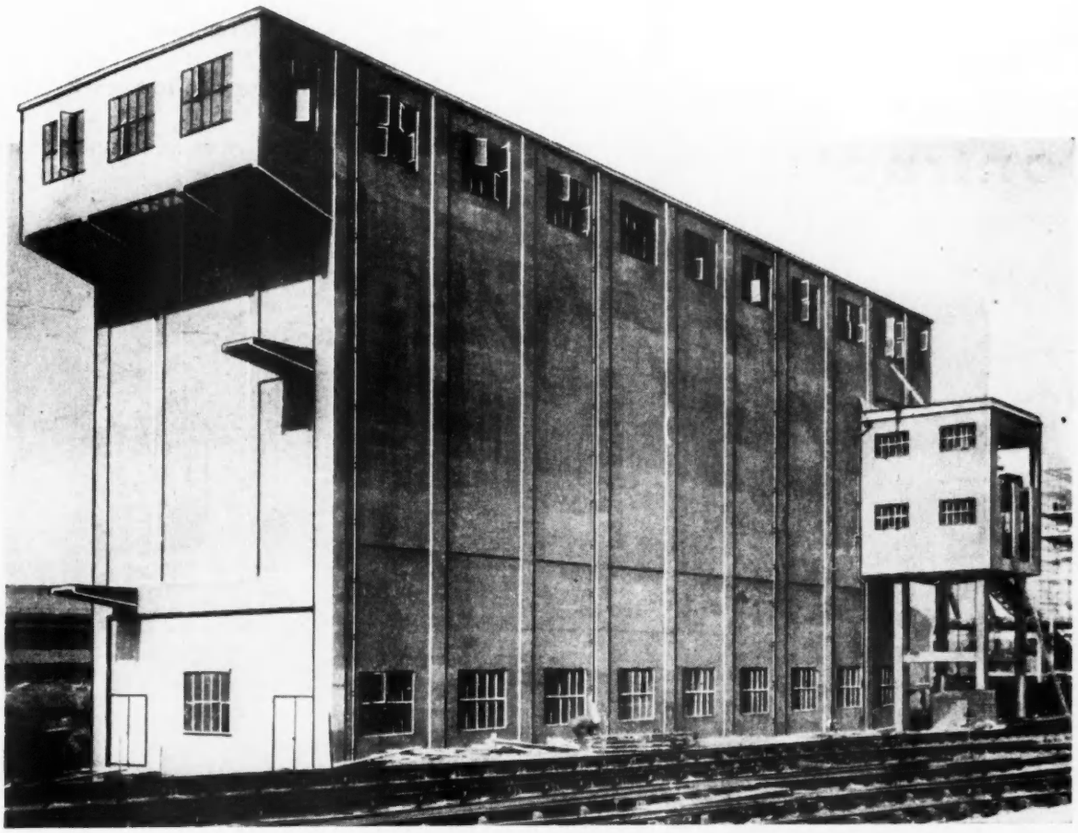

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These joints are self-adjusting and are very well made from fine materials. Used extensively on steering connections for every class of road vehicle, they are also valuable in a great many applications in general engineering, where their use can often save specially-made joints and at the same time give an improved result by eliminating backlash.

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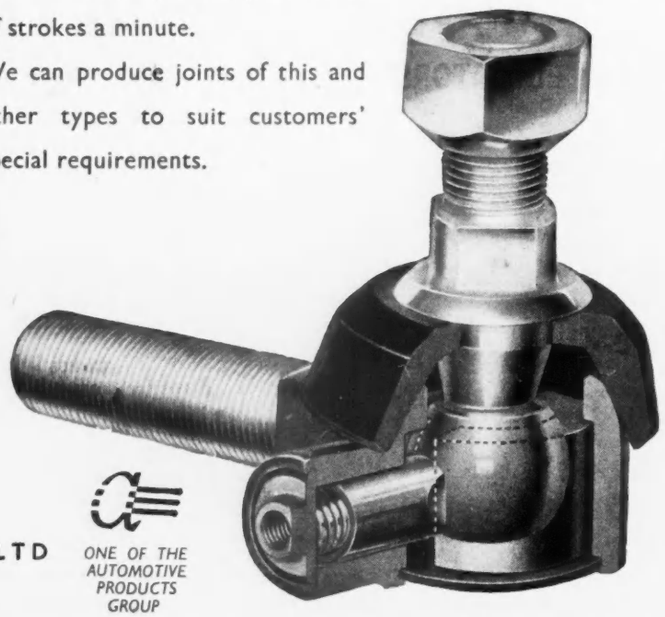

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*and prevent atmospheric pollution in the most efficient and economical way*

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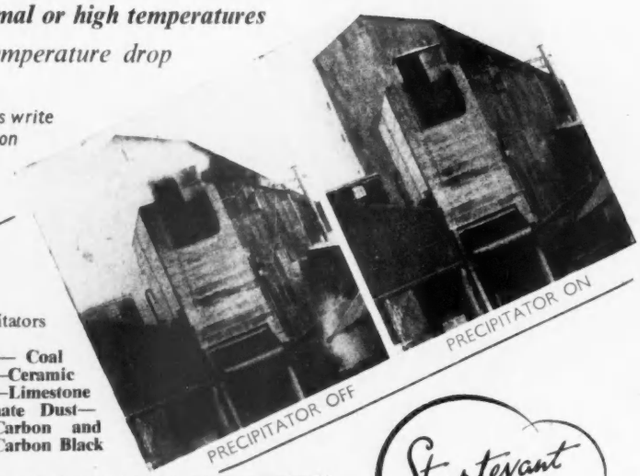


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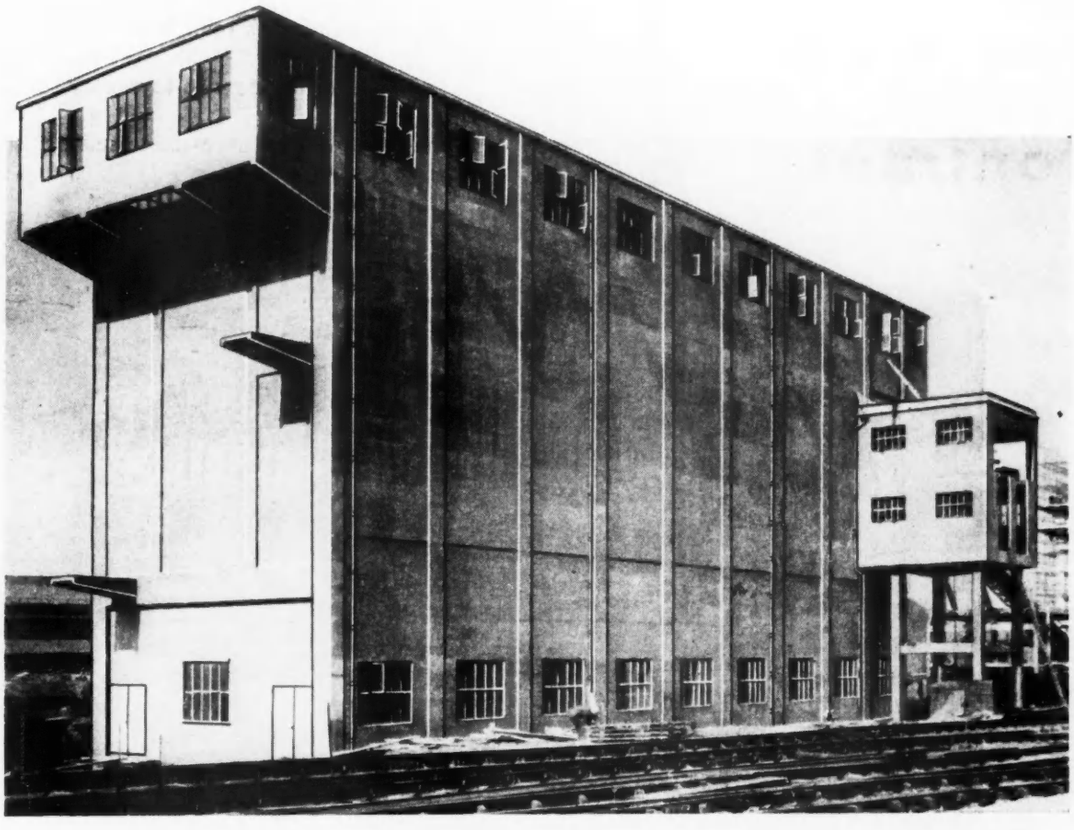

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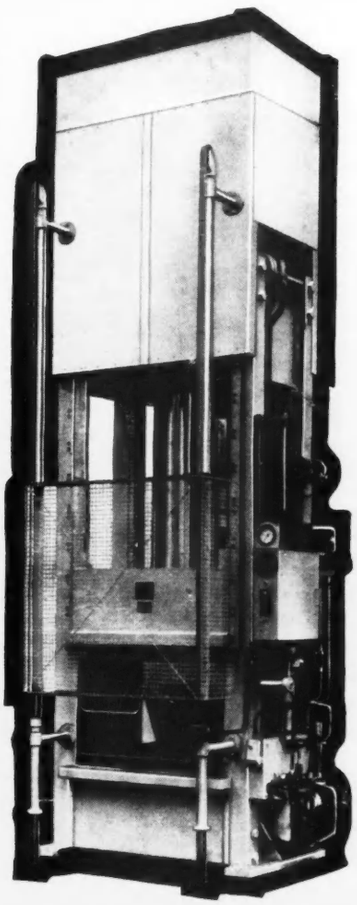

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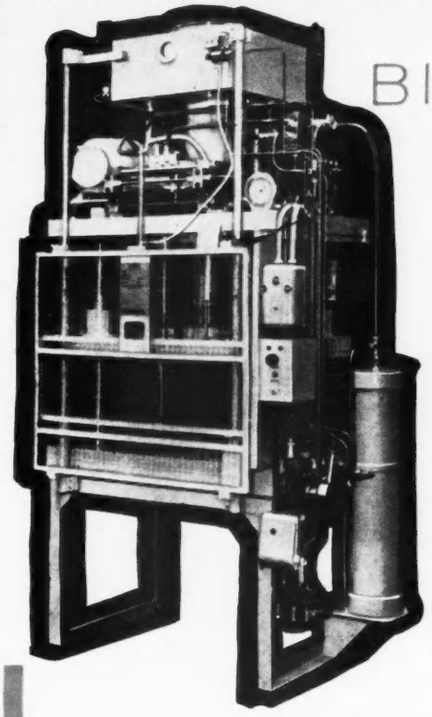

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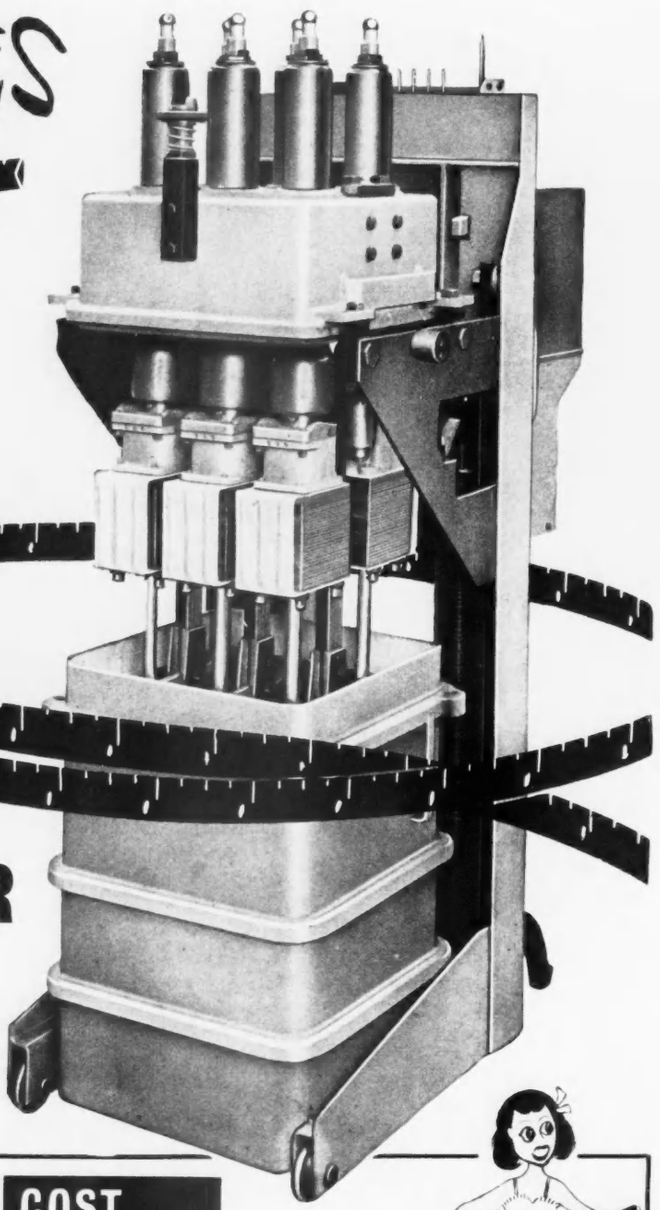

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Designed for installation in standard J. & P. metalclad switchgear (Type AG, air-insulated, and Type FG, compound-filled). This gear is of the vertical isolation drawout pattern and is only 1′ 9½″ wide.

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| Certified breaking capacities | : | 350 MVA at 11 kV |
| | : | 250 MVA at 6.6 kV |
| | : | 150 MVA at 3.3 kV |

Also tested for 250 MVA at 13.8 kV

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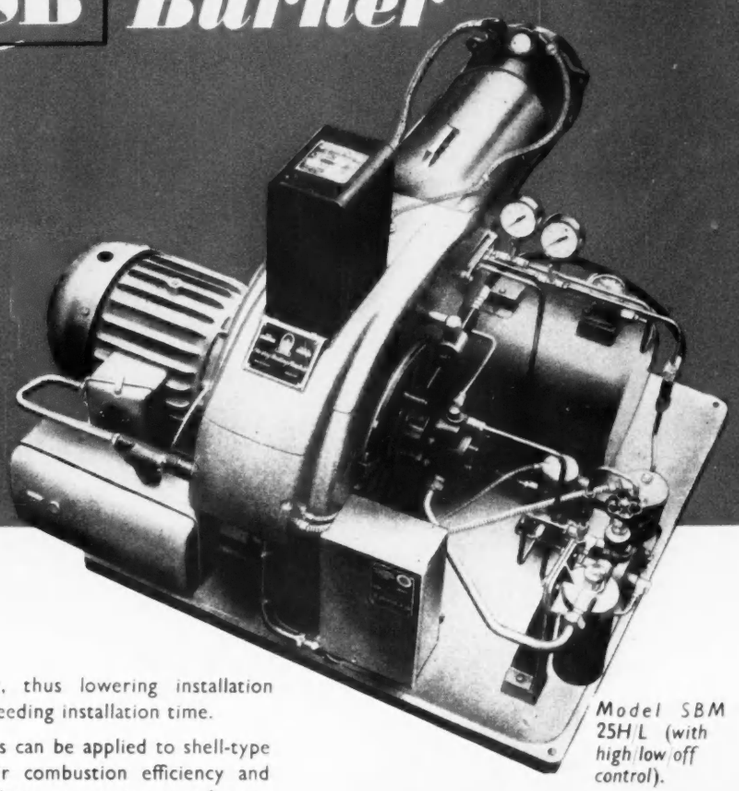
## Another Nu-way thoroughbred! by EXPERIENCE out of MODEL ZH



*Model SBM 25H L (with high/low/off control).*

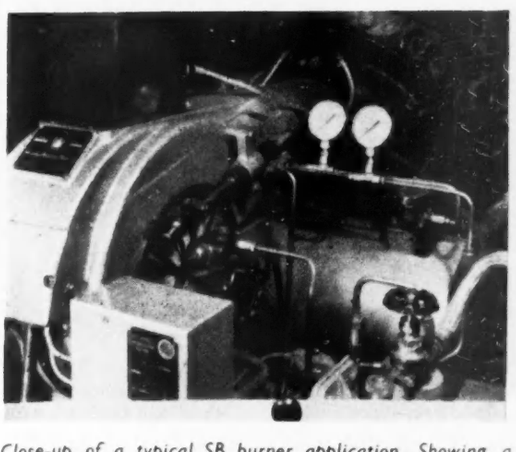
Developed from the Model ZH, Nu-way's outstandingly successful series of fully automatic commercial burners, the new SB models are primarily intended for the efficient firing of steam boilers at lower capital cost. SB burners are also particularly suitable for firing any other boilers which offer high resistance to the flow of combustion gases. To achieve this the fan pressure on the SB design has been substantially increased to produce a convergent air blast at the nozzle which is strong enough to play a significant part in atomising the oil and promoting rapidly completed combustion. The resulting flue gas velocity is high enough to overcome very substantial boiler and flue resistance which would cause ordinary burners to pulsate and smoke.

One important advantage of this new atomising system is that the combustion chamber volume required for a given rate of firing is greatly reduced. Vertical boilers fired with the SB burners can usually accommodate a fire-box of sufficient size without excavation or extending the boiler skirt, thus lowering installation costs and speeding installation time.

SB burners can be applied to shell-type boilers, their combustion efficiency and cost of installation comparing most favourably with other more cumbersome oil-firing systems.

These new burners are now being produced in a wide range of sizes for different grades of fuel. The various groups are : Model SBL, for light distillate oils and Models SBM and SBH for medium and heavy fuel oils respectively.

Full details of Models SBM and SBH are given in our, newly published, Data Sheet No. D7A. Details of Models SBL are in course of publication pending which advance information will be supplied upon request. All but the smallest SB burners can be supplied with Nu-way High/Low/Off control. This high/low flame equipment which is standard on all larger SB models gives appreciable fuel savings, inhibits pulsation on light-up and stabilizes steam pressure.



*Close-up of a typical SB burner application. Showing a Model SB17 H/L burner firing a Cochran boiler of 1500 lb./hr. evaporation, through the former stoking door. Note the ram-operated high/low air control on the fan inlet.*

**NU-WAY Oil-firing**

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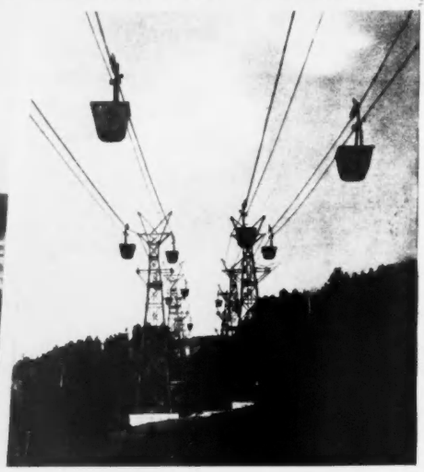

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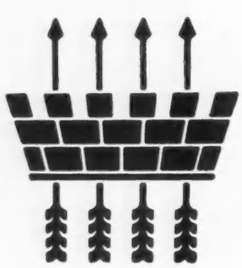

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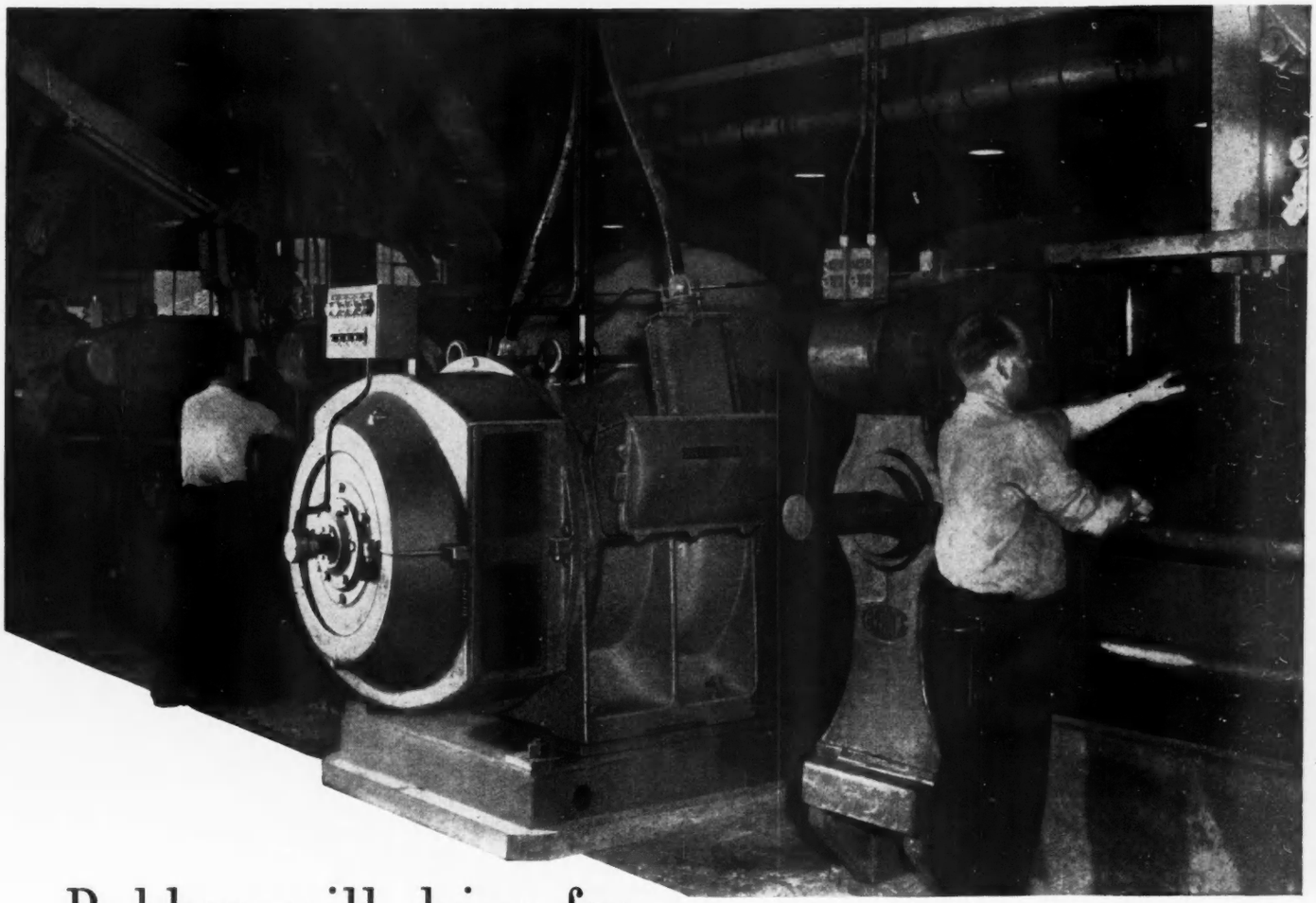

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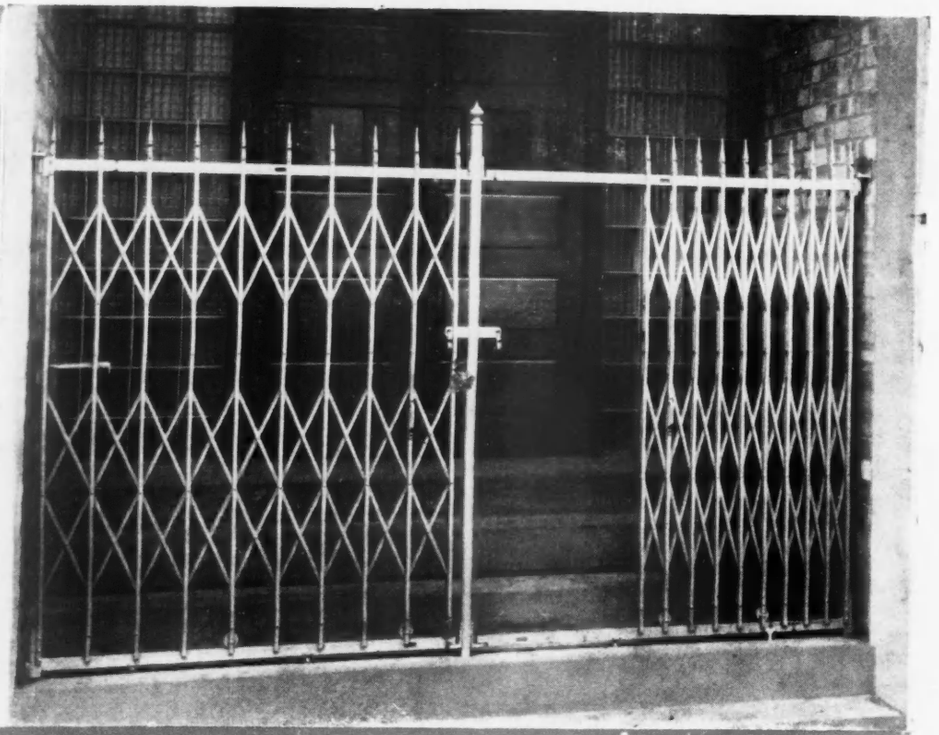

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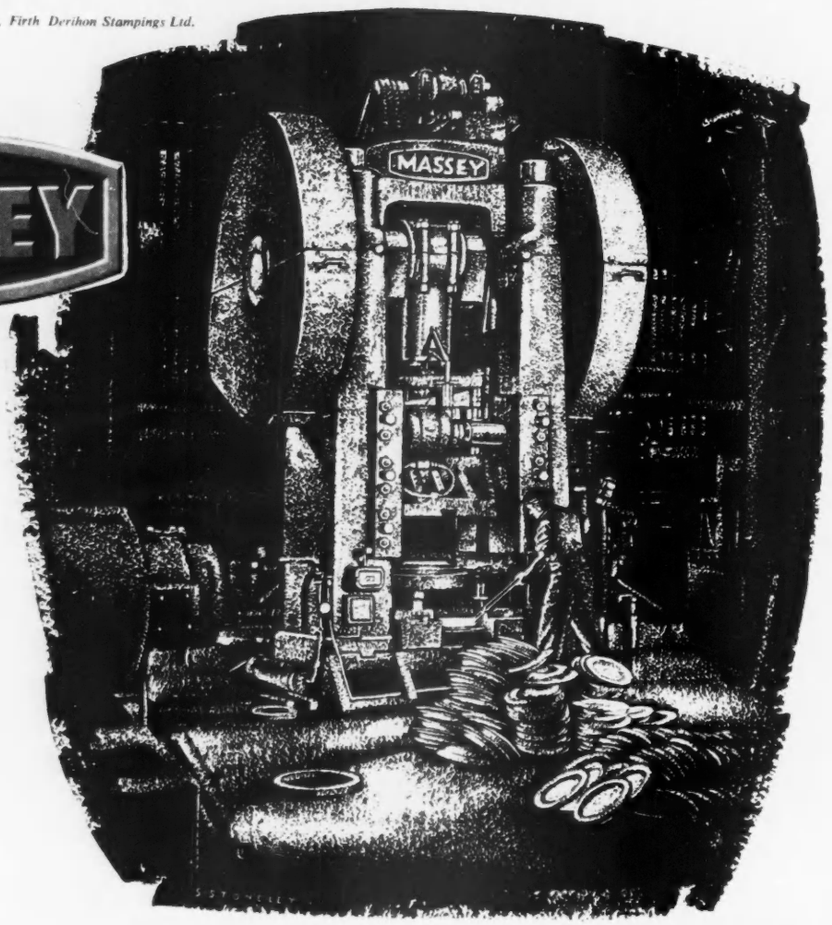


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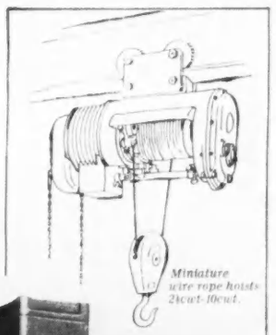
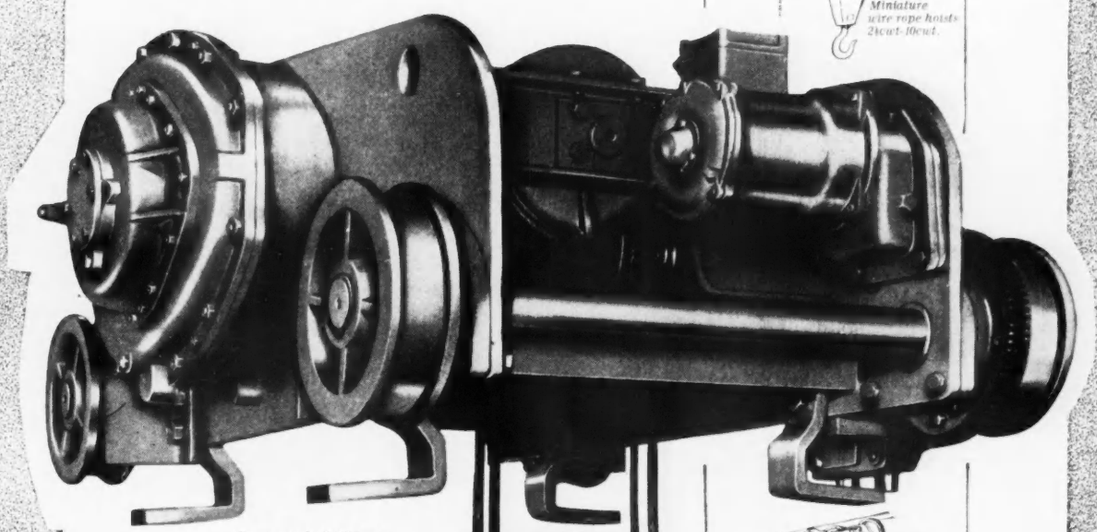


*Miniature wire rope hoists 2½cwt-10cwt.*



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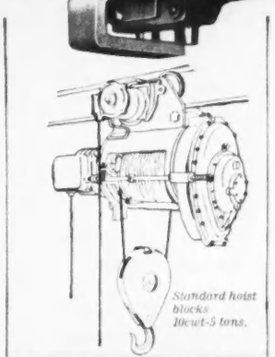

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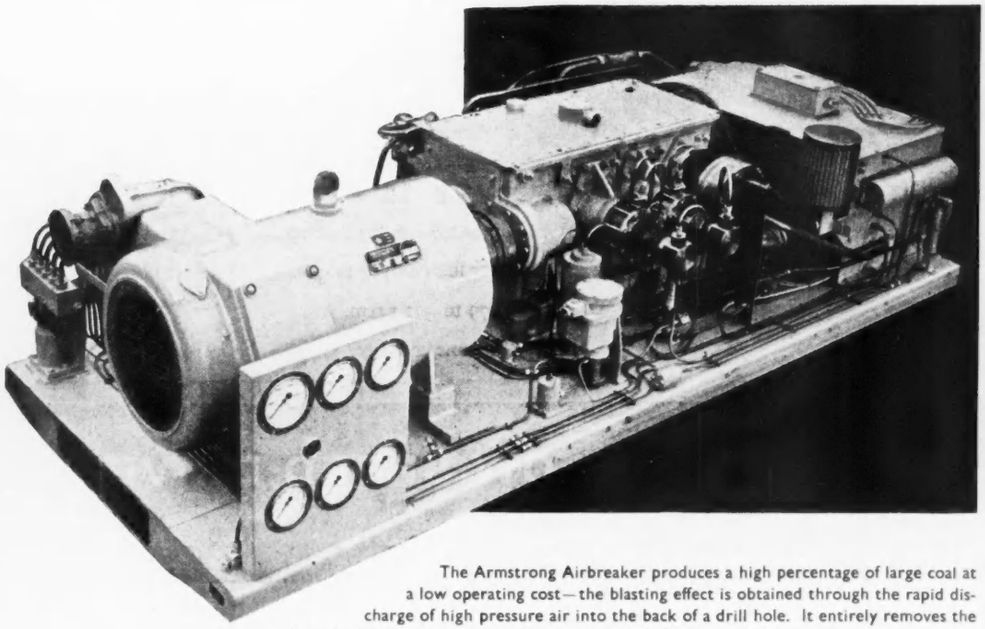

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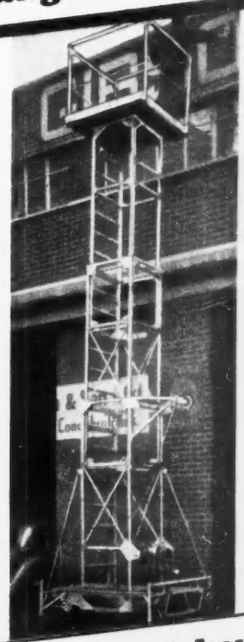

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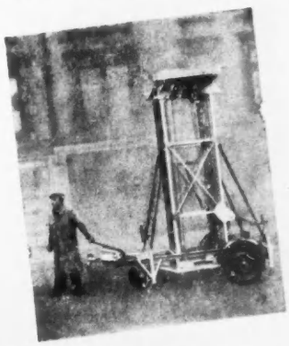

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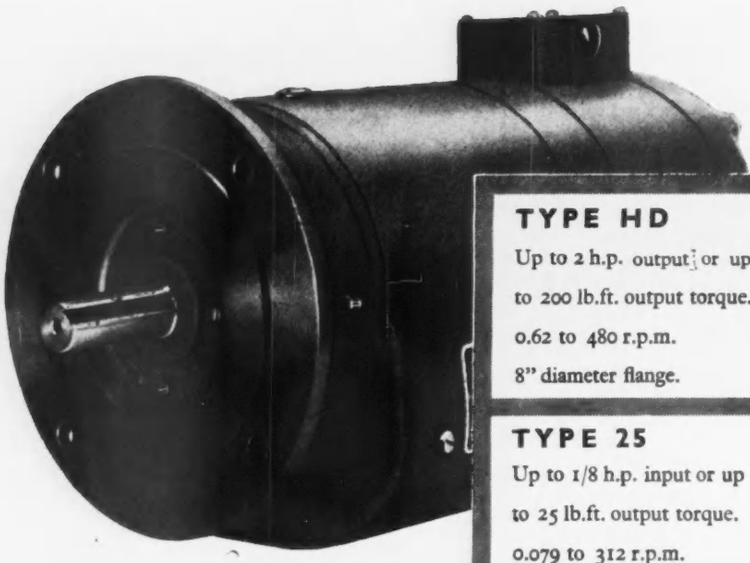

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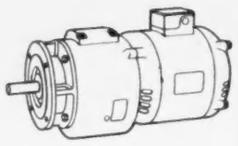

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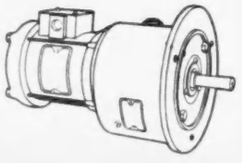

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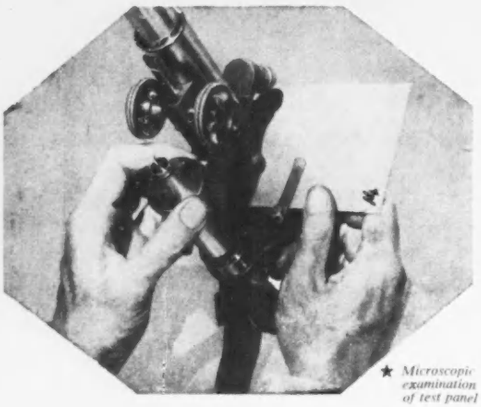

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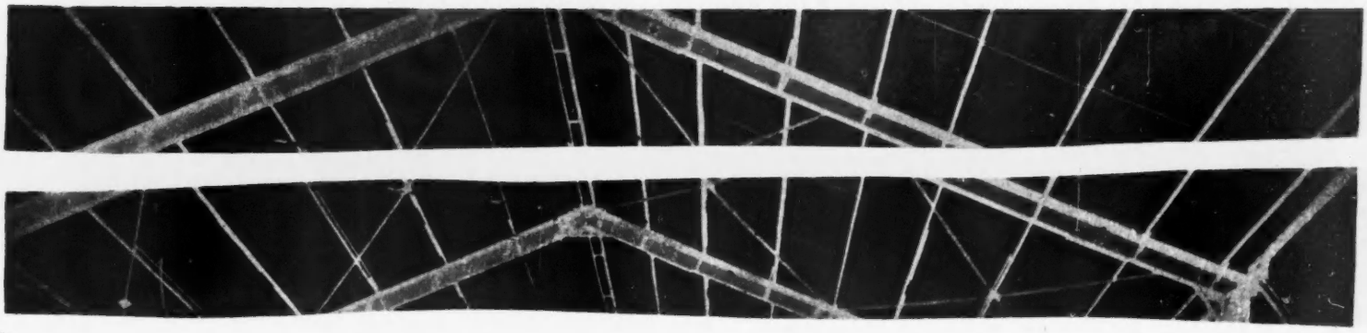

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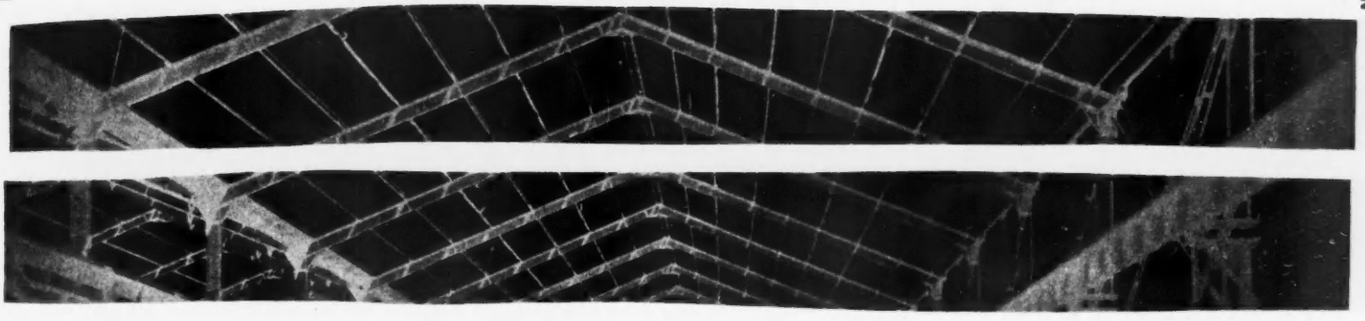

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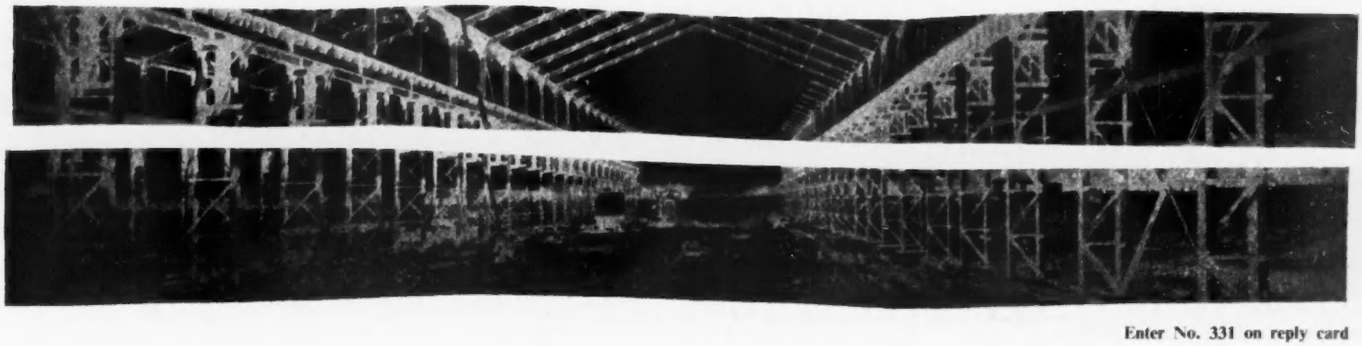

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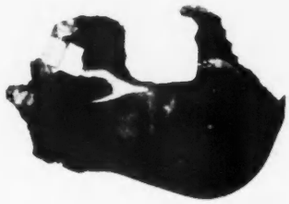

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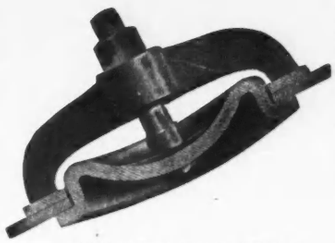

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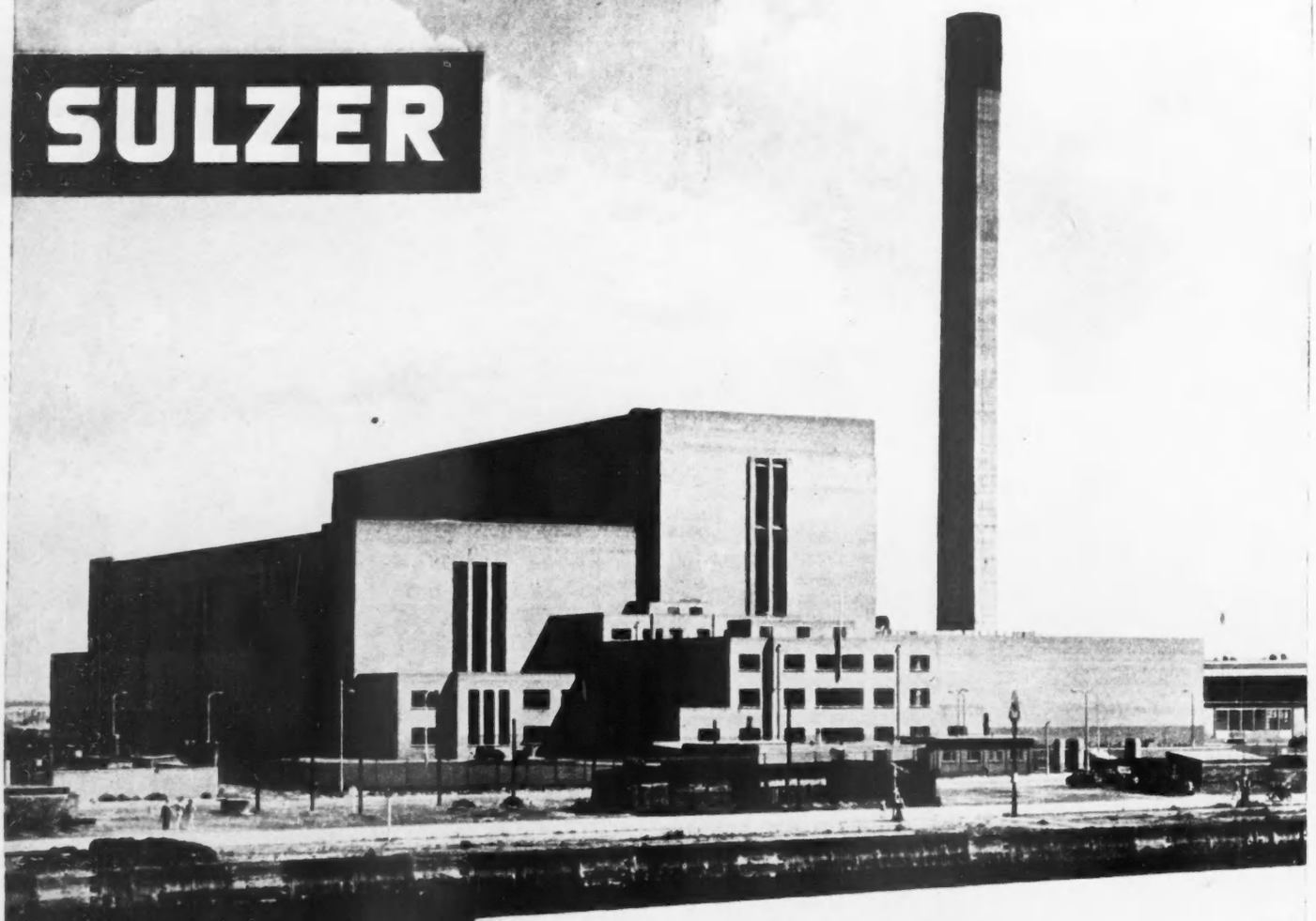

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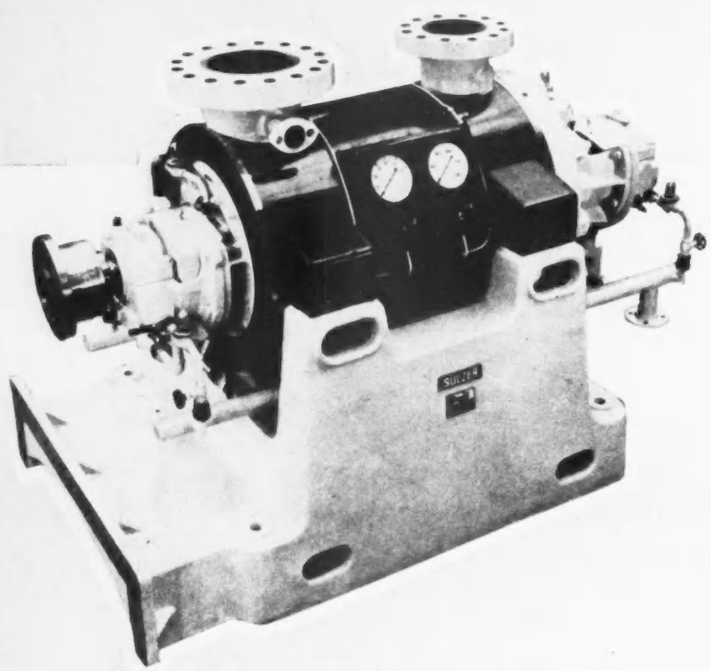

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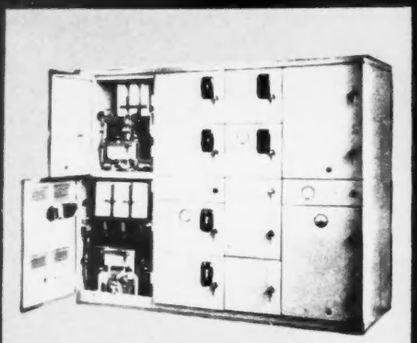

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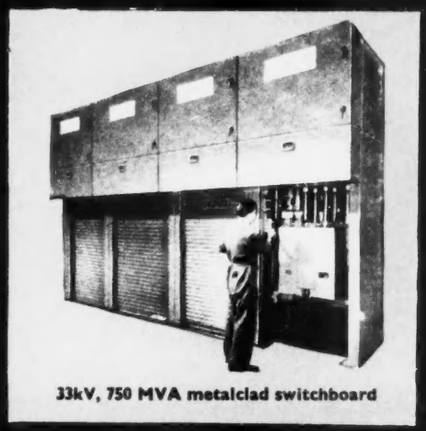
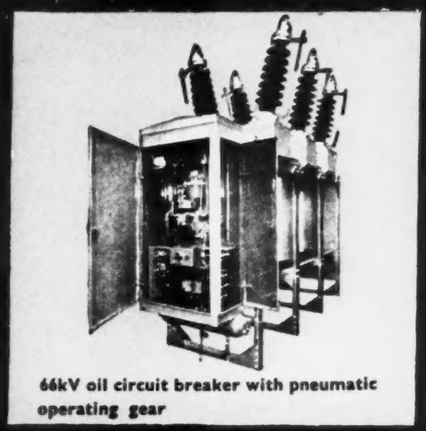
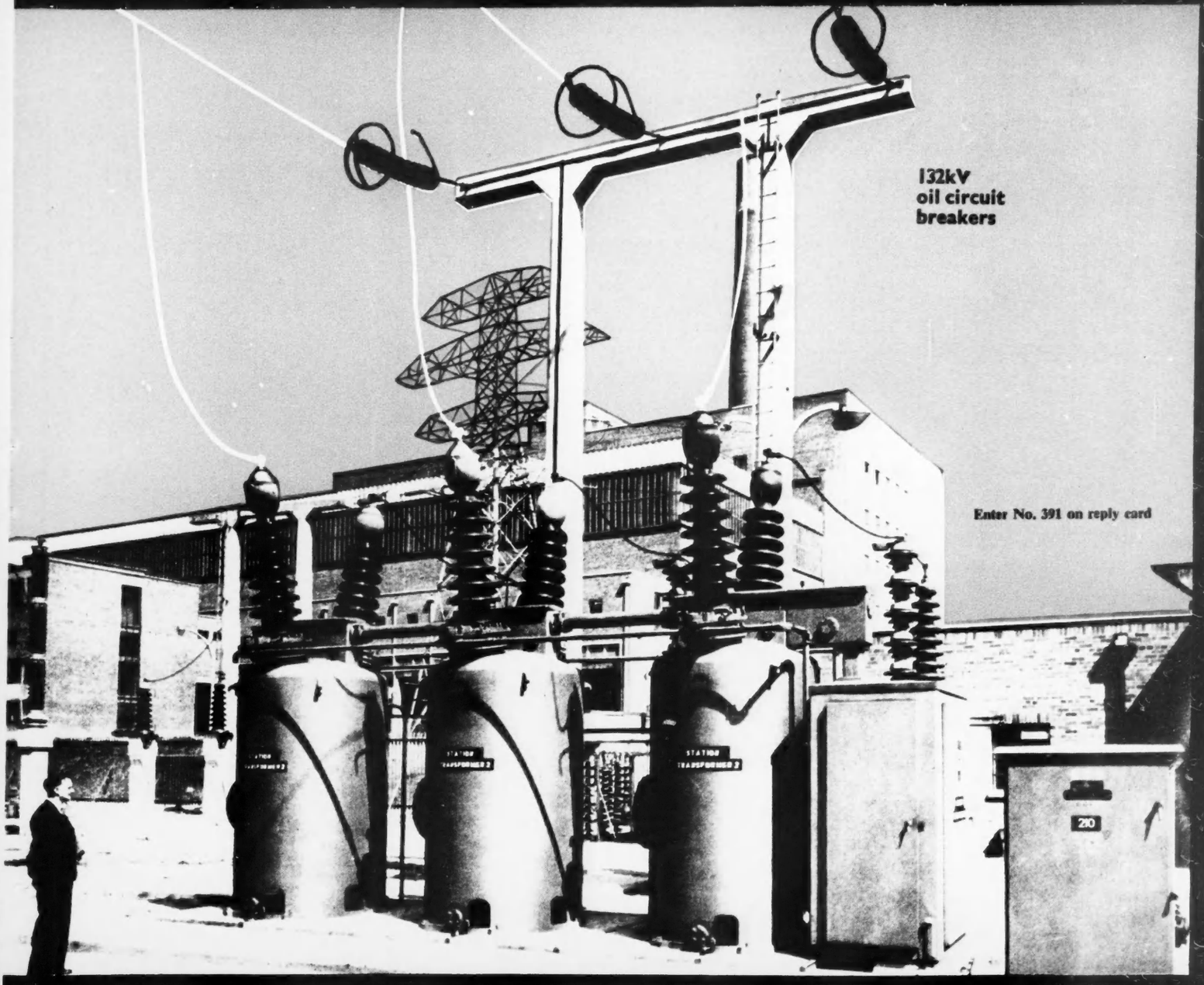


33kV, 750 MVA metalclad switchboard



66kV oil circuit breaker with pneumatic operating gear



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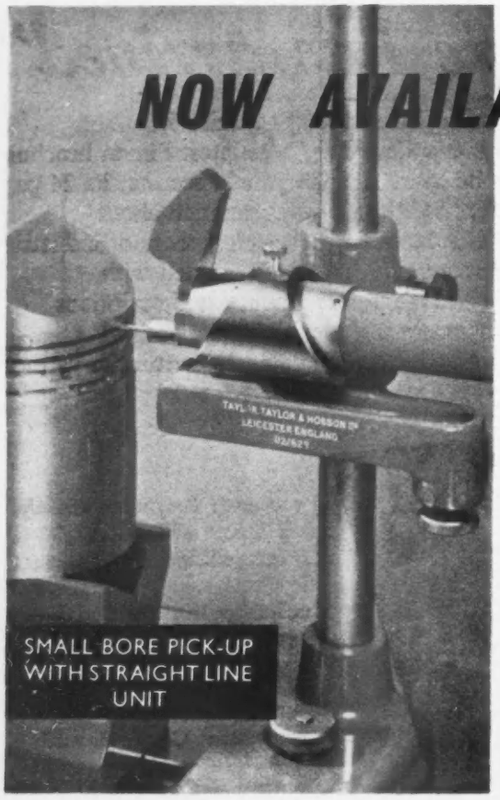


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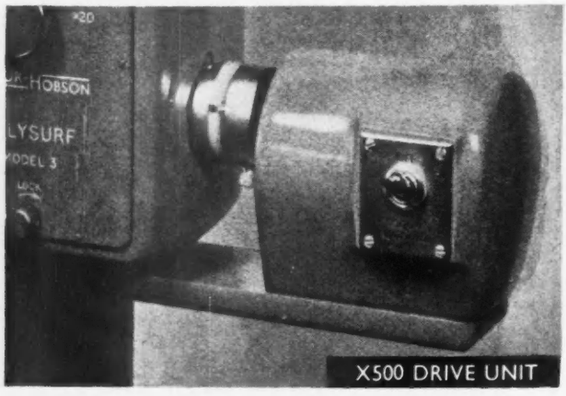


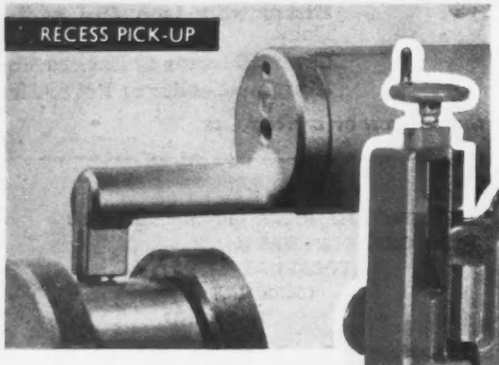


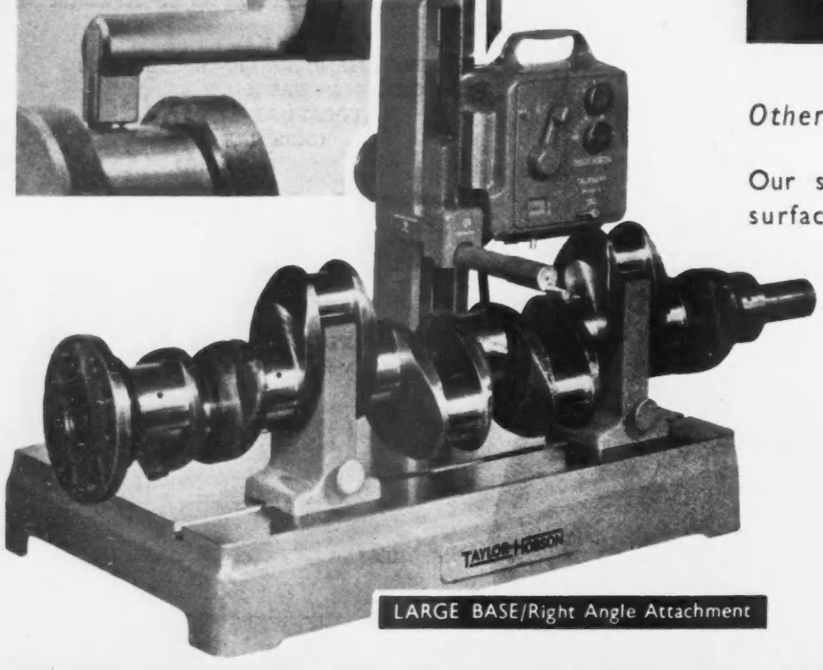


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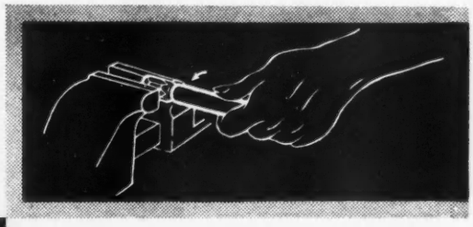

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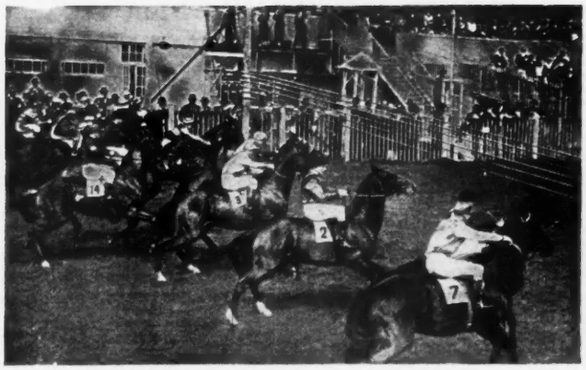

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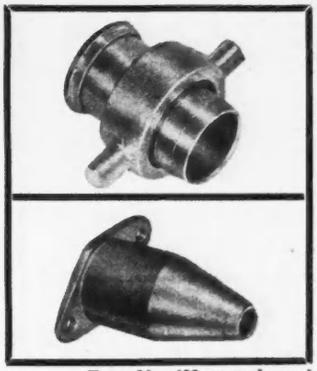

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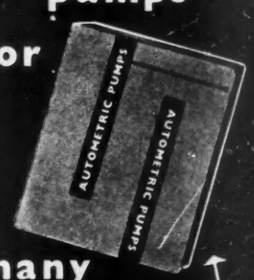


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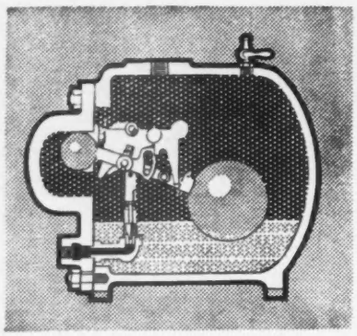

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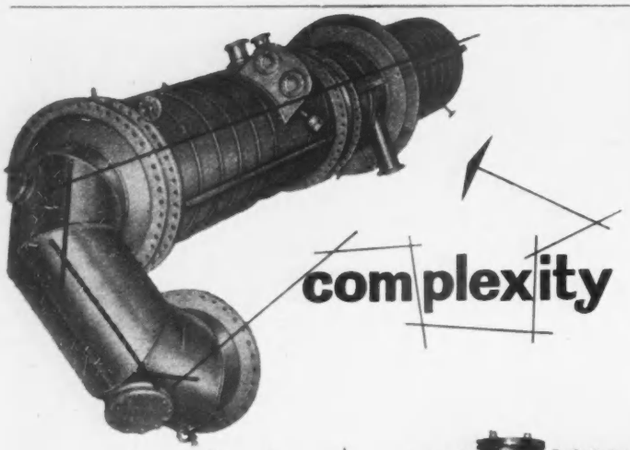

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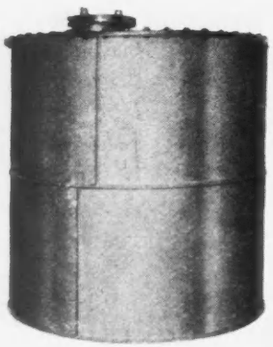

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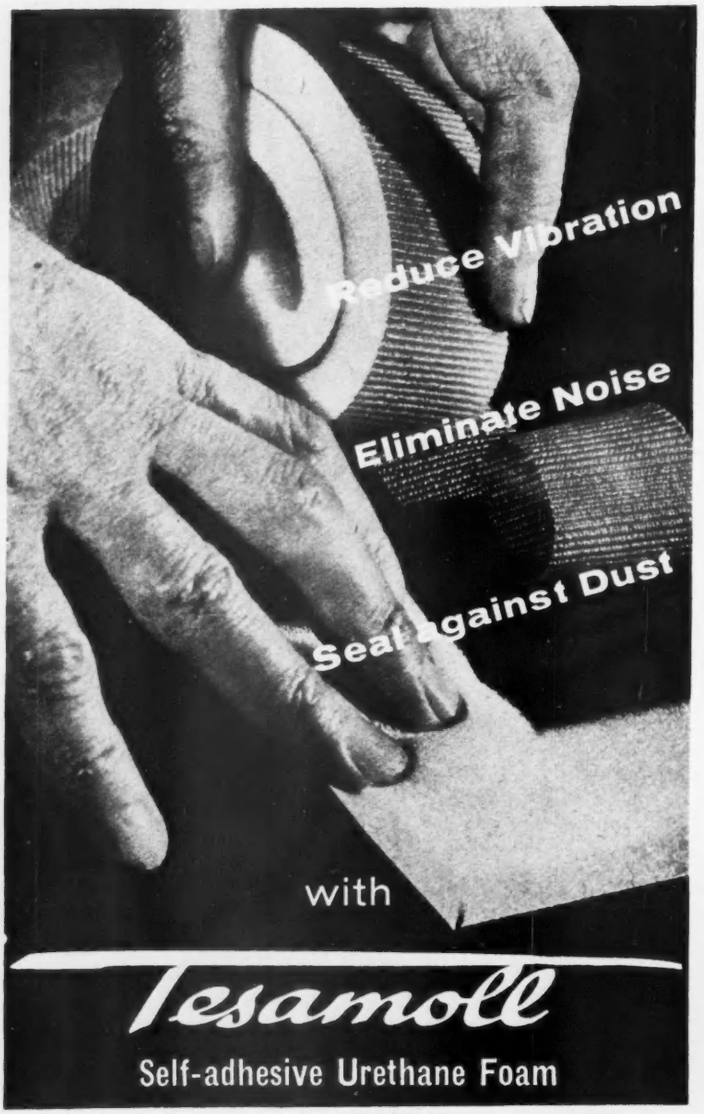


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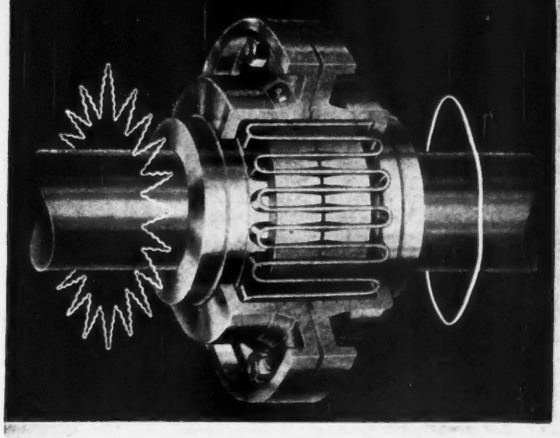

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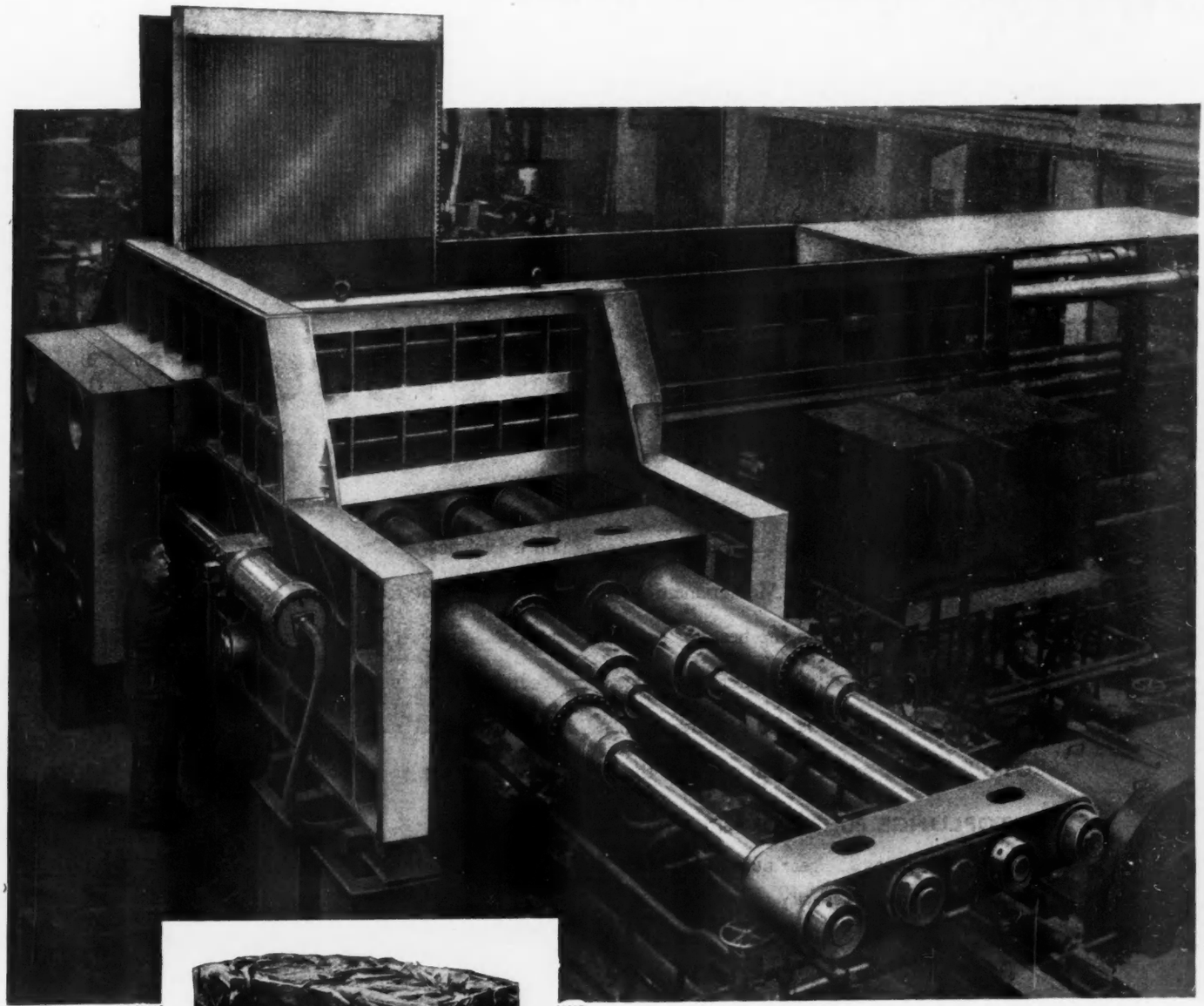

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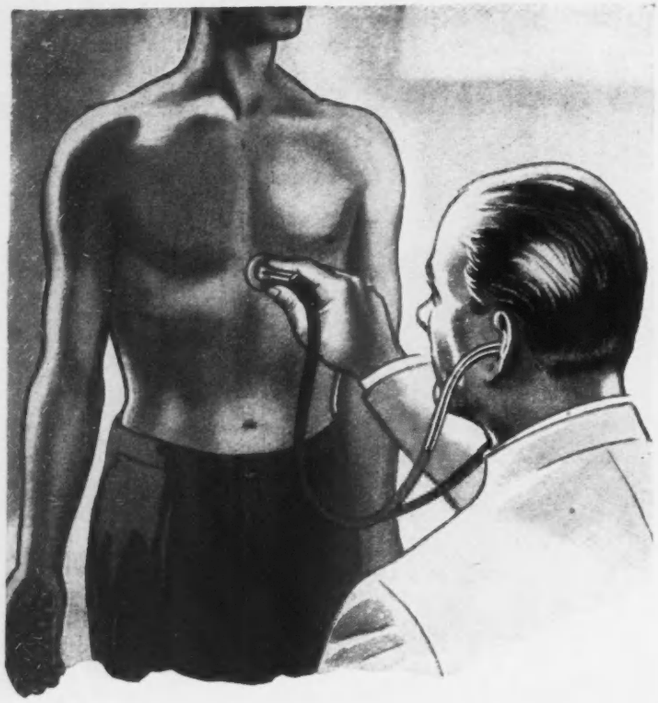

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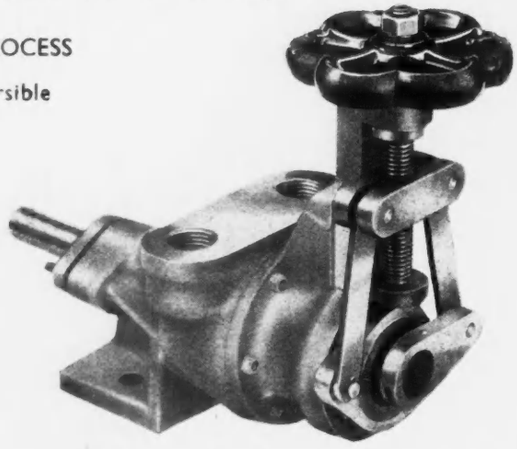

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***First in 1886 foremost today—***
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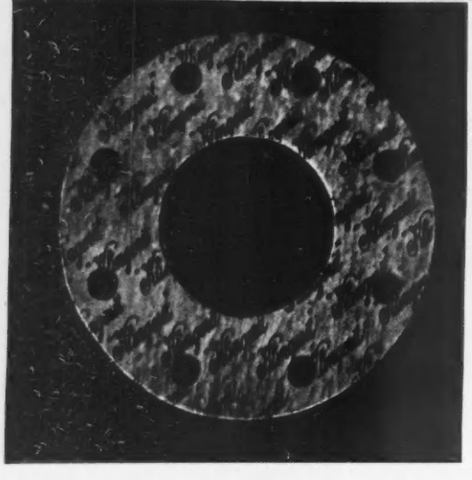
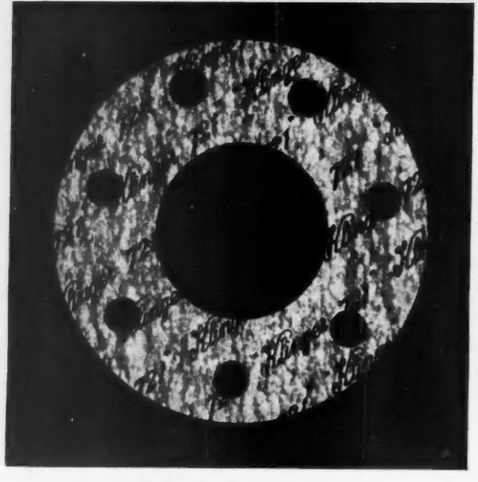


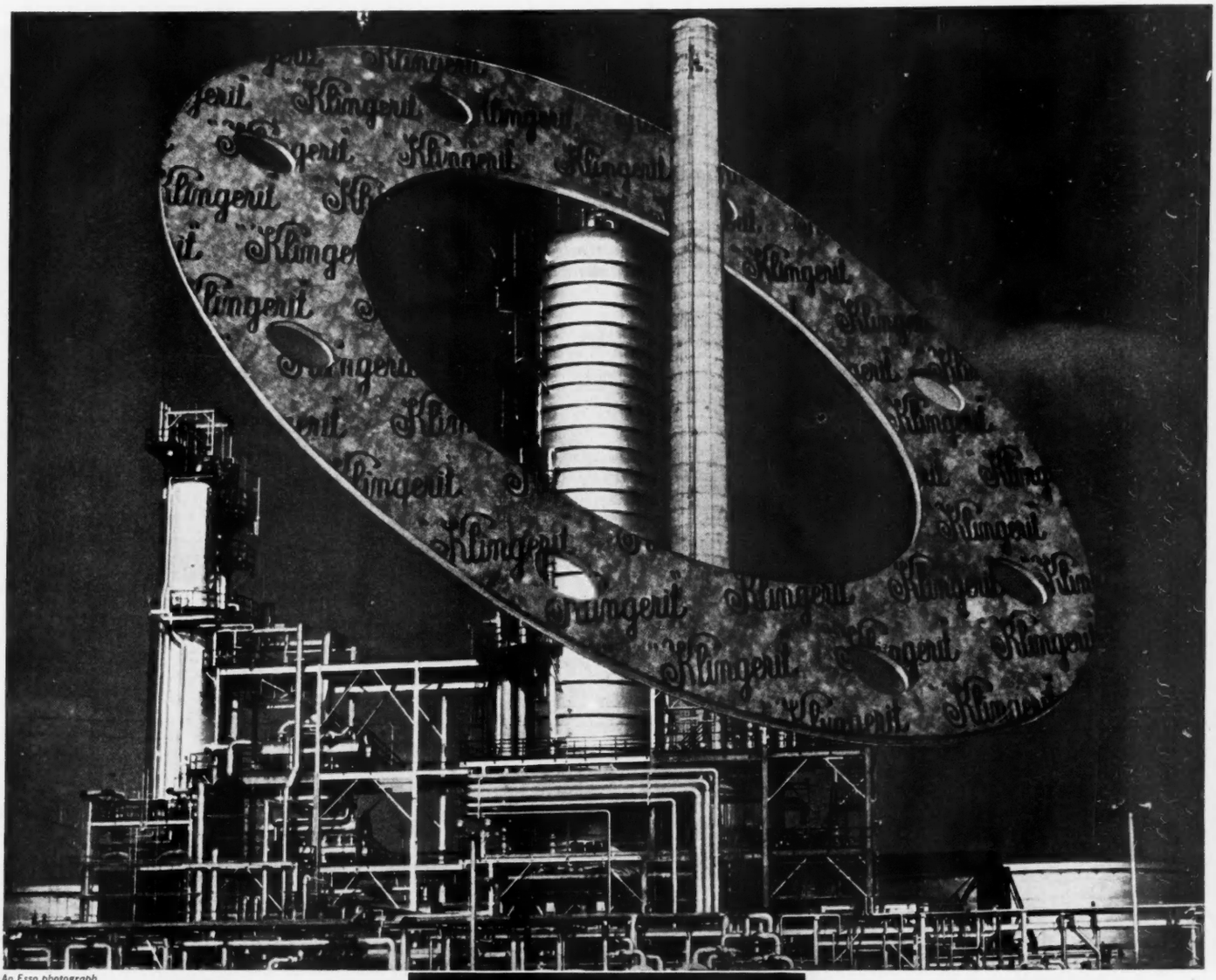
**KLINGERIT**
High-pressure compressed asbestos sheet jointing

**KLINGER 1000**
Wire-reinforced jointing

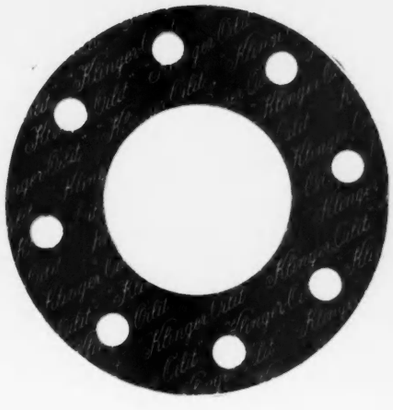


**KLINGER 721**
Oil-resistant compressed asbestos jointing for the Aircraft Industry

**RICHARD KLINGER LIMITED** ***Klingerit Works***

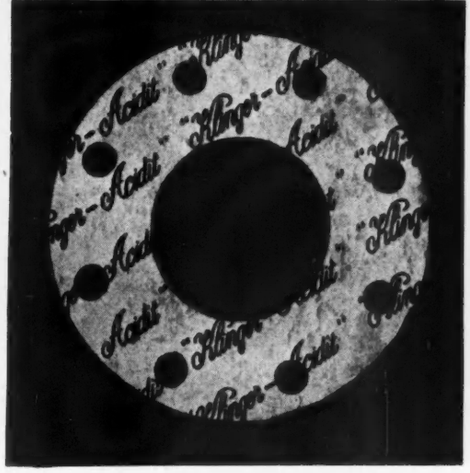



An Esso photograph



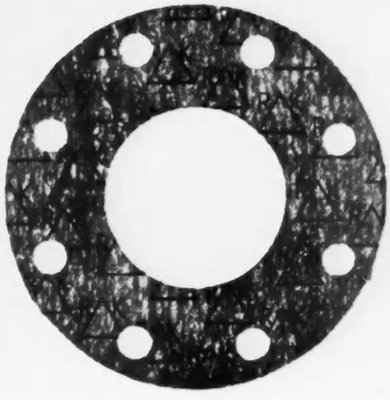
**KLINGER OILIT**

Jointing especially made for use with oils and all hydro-carbons




**KLINGER ACIDIT**

The acid-resisting compressed asbestos jointing



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Steam and Oil jointing

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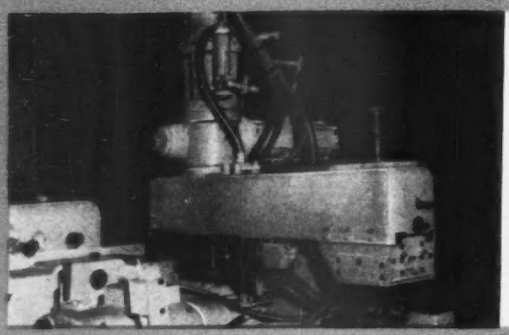

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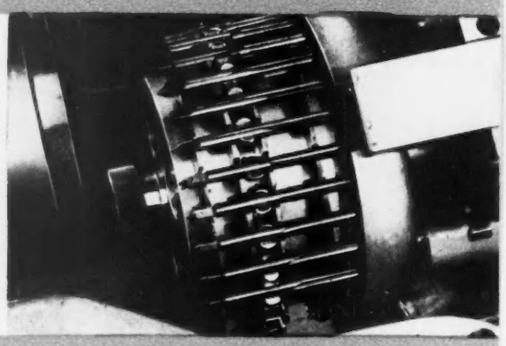
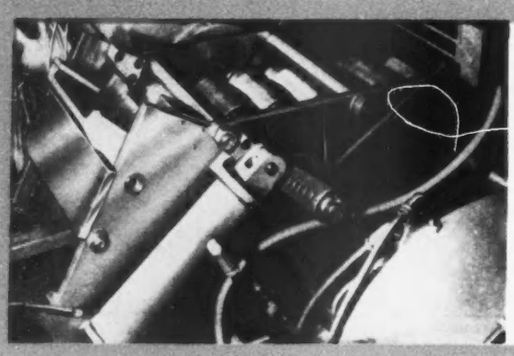
for link-line production of lay cluster gears.

## INDEX & PUSH

for fully automatic tap production.





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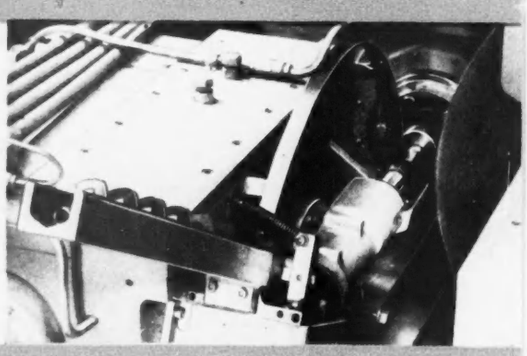
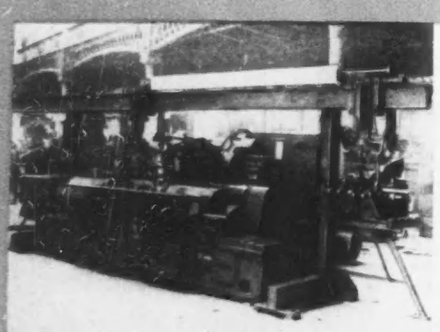
## SWIVEL

for high-speed grinding of rotor cams and skirts.





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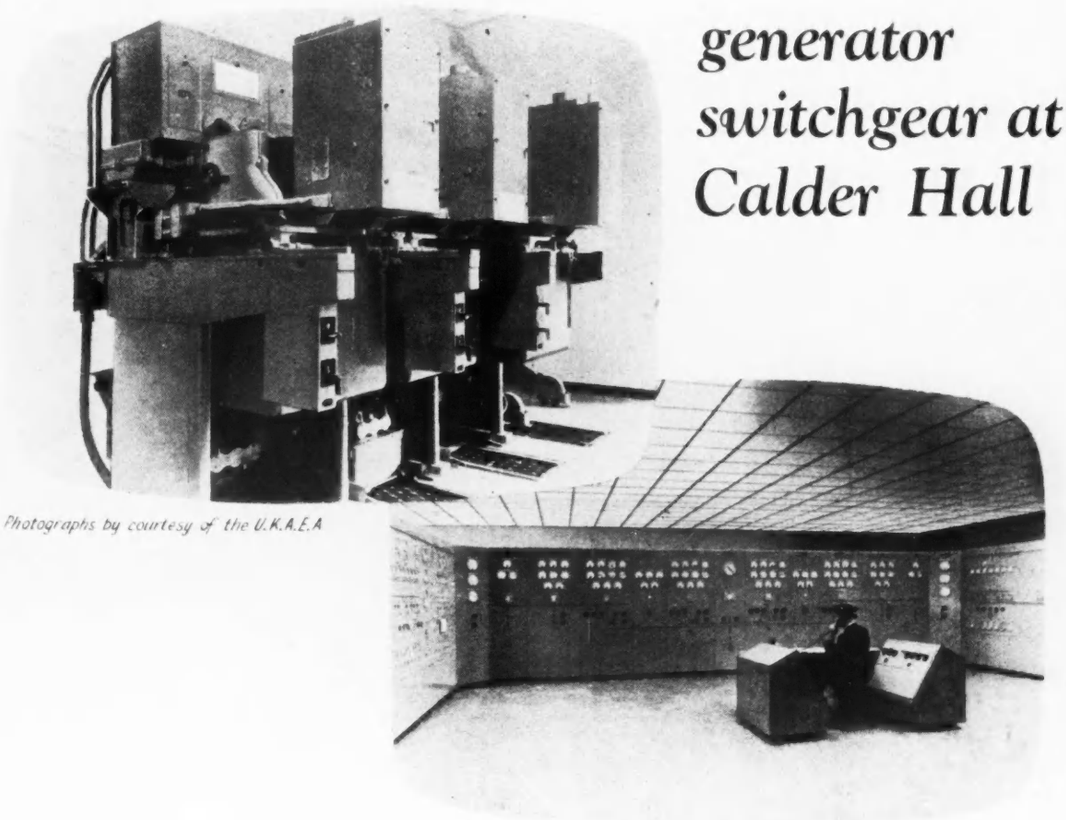

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The generators at the Calder Hall Power-station of the Atomic Energy Authority are controlled by Reyrolle 11-kV 500-MVA and 750-MVA switchboards and their associated control-boards

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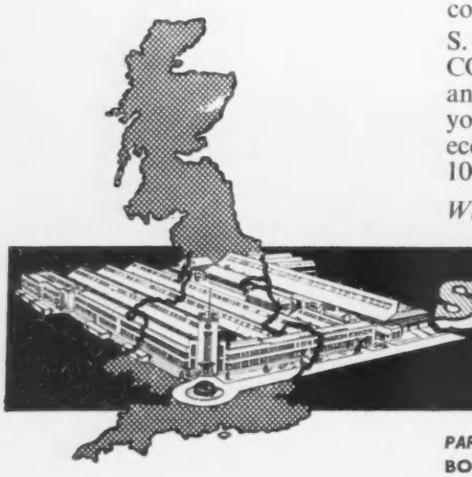
*Write to the Sales Director for immediate attention to your enquiries.*



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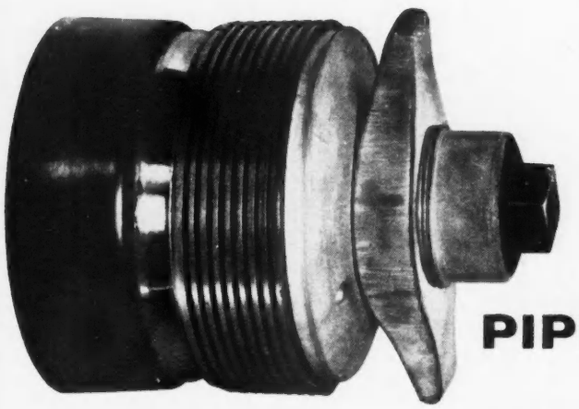

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*The higher the pressure, the tighter the stopper*

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*The cone lock pipe stopper in position.*

*The stopper is easily removed after testing by slackening the wing nut.*

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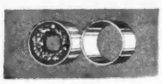

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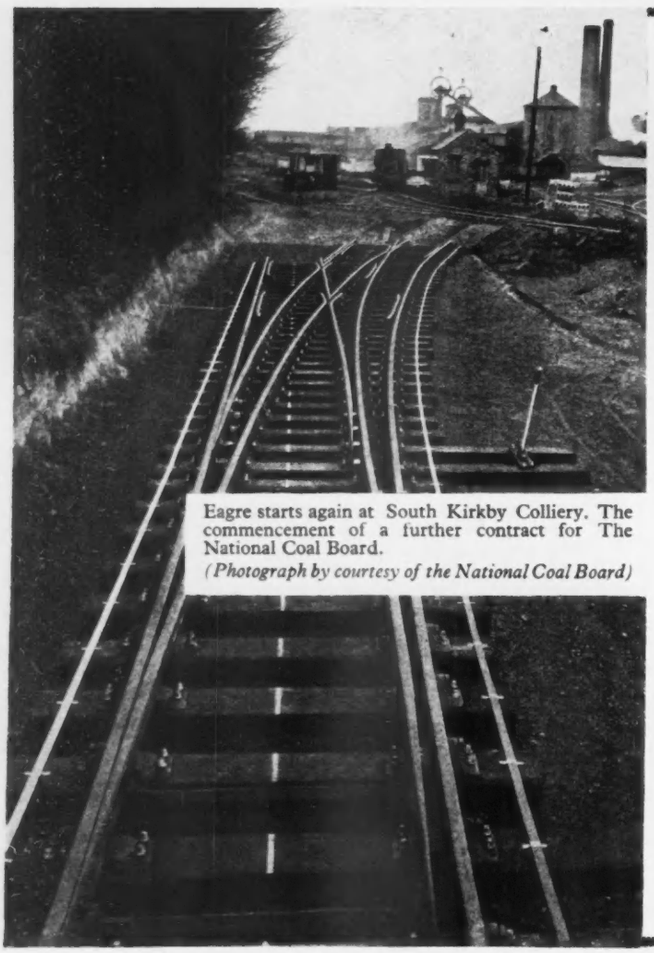

Eagre starts again at South Kirkby Colliery. The commencement of a further contract for The National Coal Board.
*(Photograph by courtesy of the National Coal Board)*

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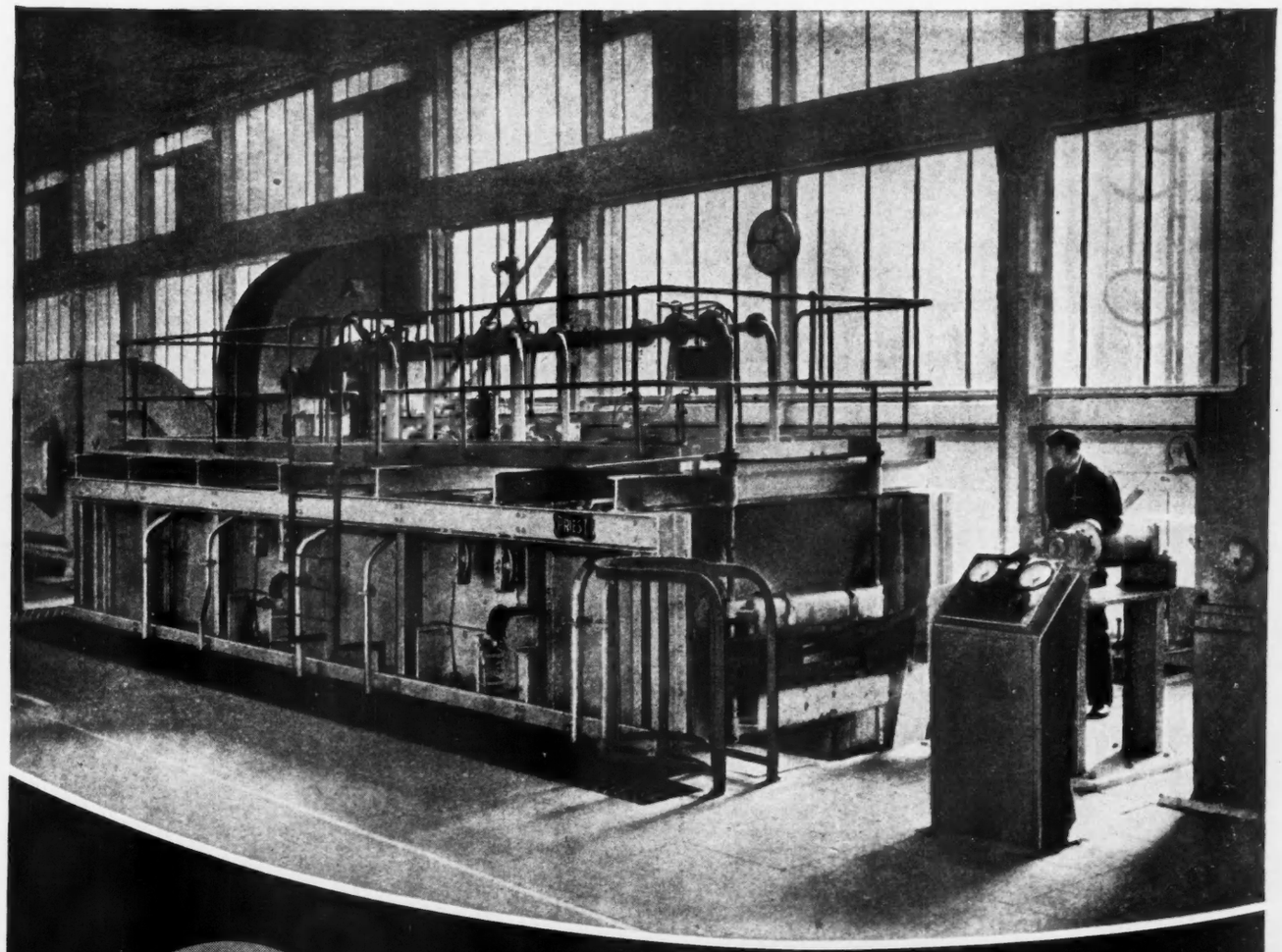

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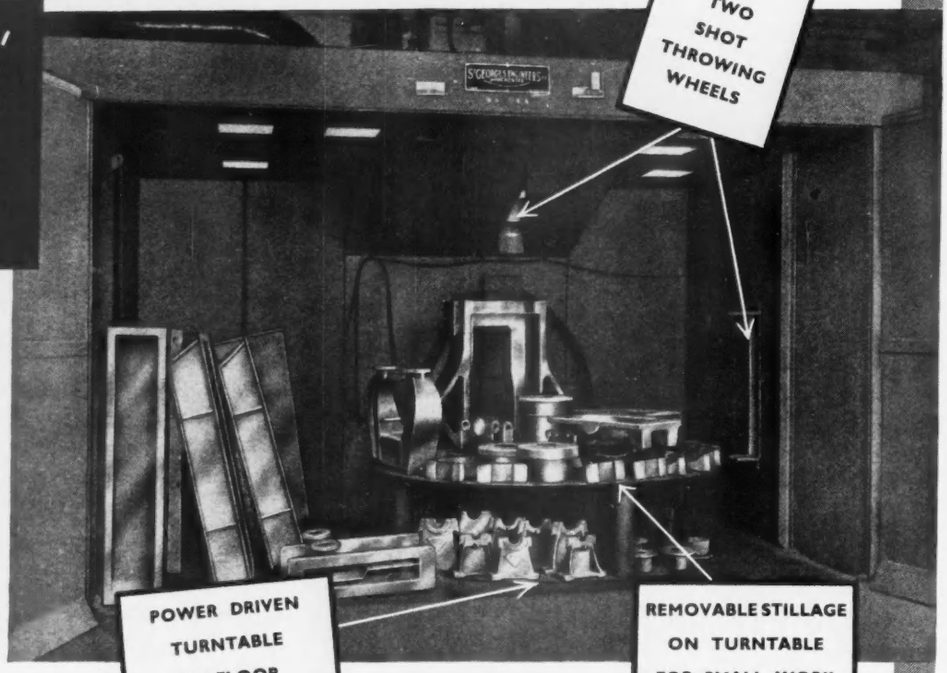


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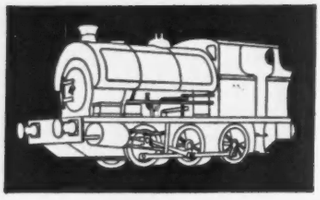

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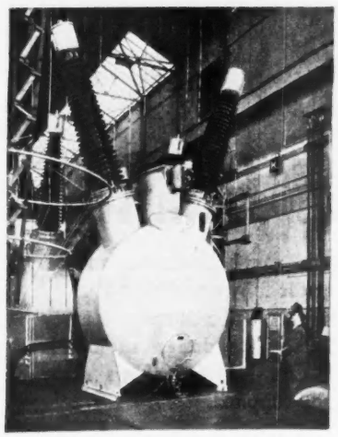

The illustrations show a complete 330 kV. bushing insulator and a 330 kV. circuit breaker, by courtesy of the B.T.H. Co.

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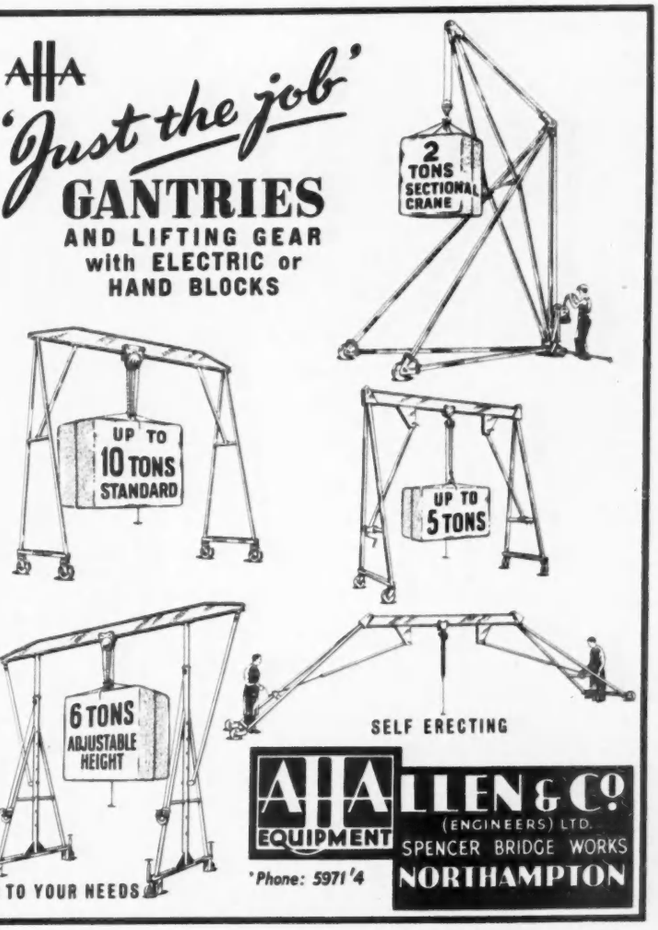


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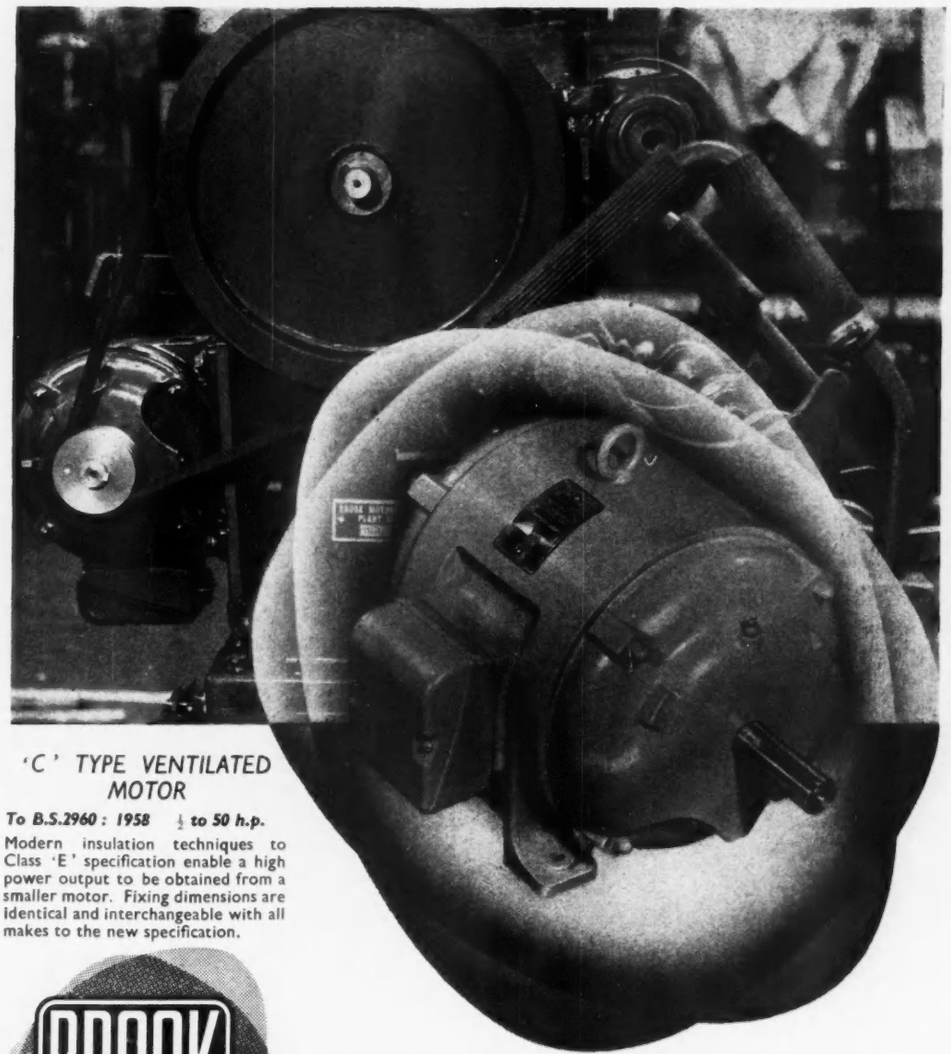

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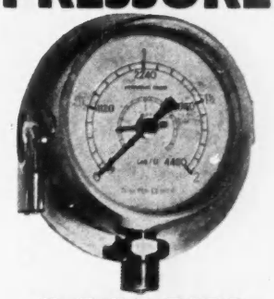
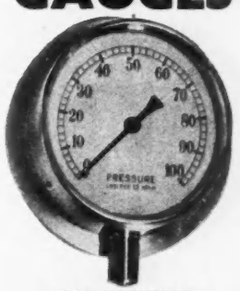


**GAUGES**



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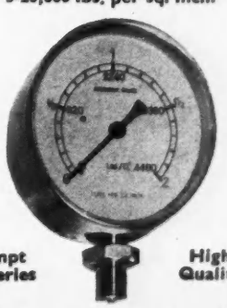

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* Better than $\pm 1\%$ on flat surfaces.

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*Information Service Leaflet FB721 describes fully the*

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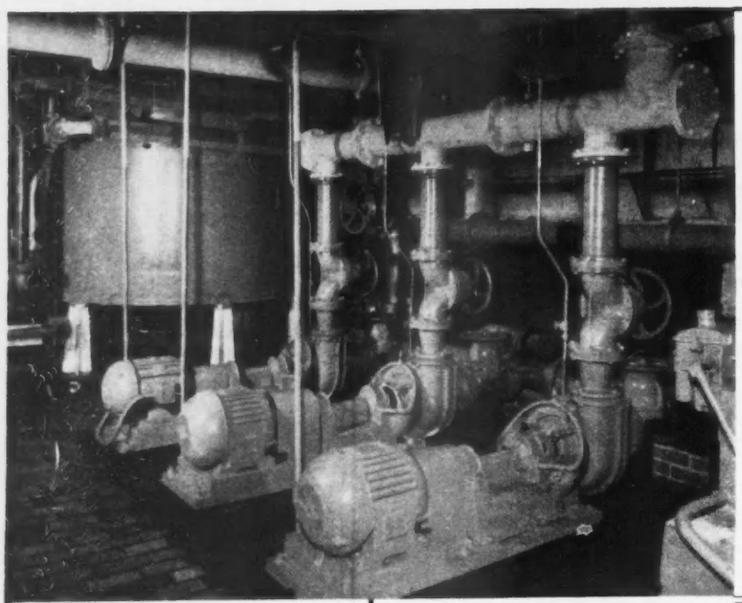

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Chromic Acid and Nickel Solutions for electrolytic plating plants including pumping to filters, etc

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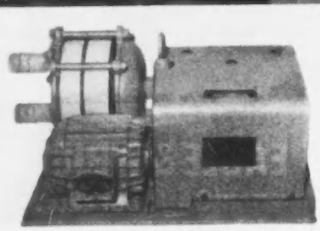
Pumping of demineralised water

*(Top left) Large battery centrifugal acid pumps*
*(Bottom left) Close-up view of diaphragm pump similar to the hand operated unit but arranged for motor drive*
*(Bottom centre) Hand operated portable diaphragm pump for emptying carboys or tanks and for general duties.*
*(Bottom right) Portable rotary displacement pump pumping plating solutions in the motor car trade*



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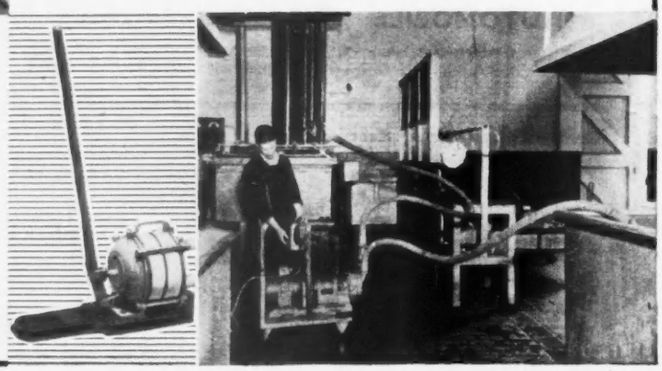

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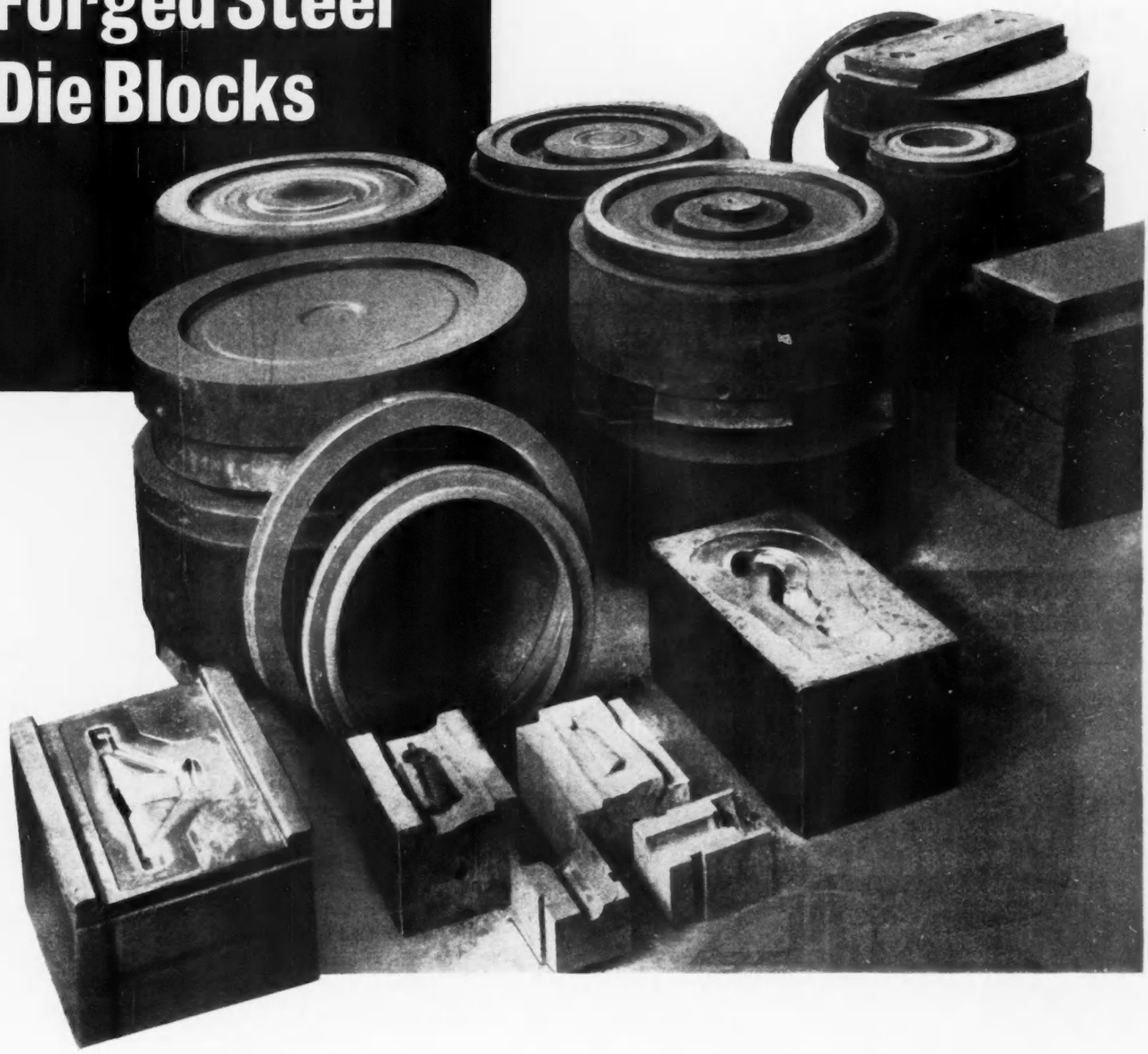

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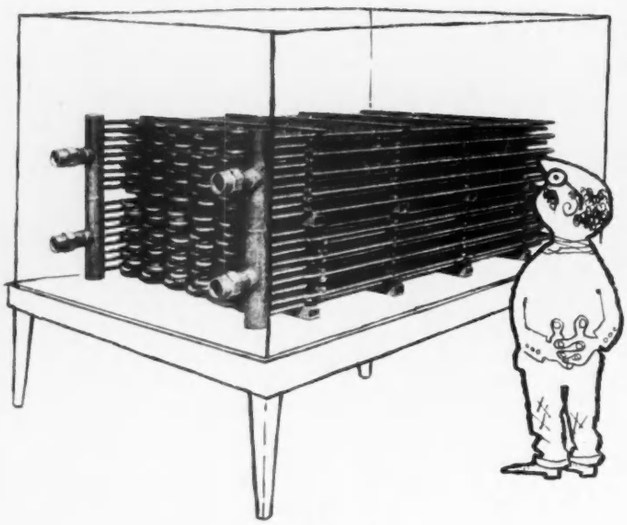

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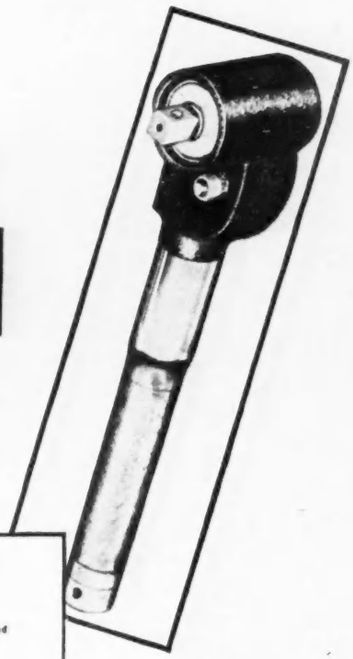

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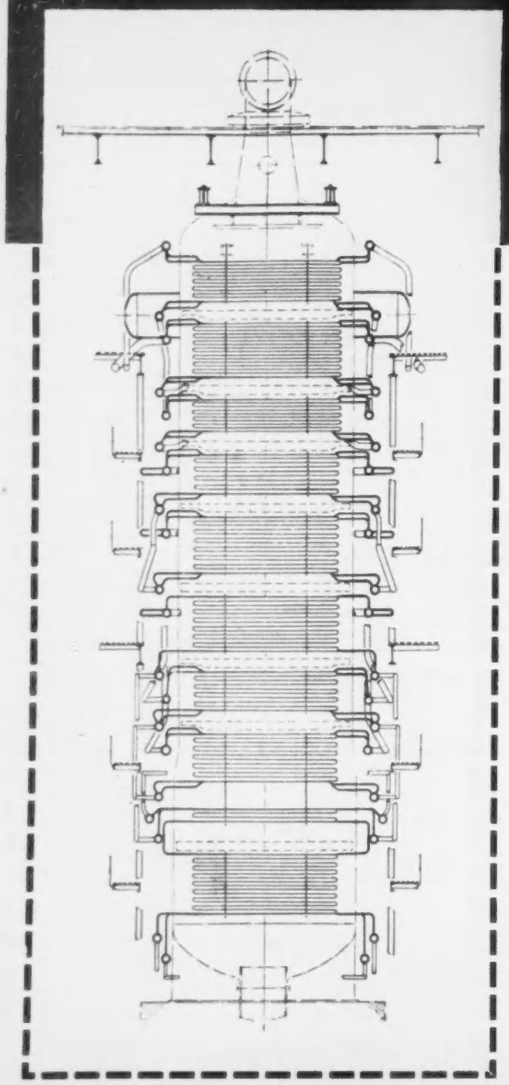

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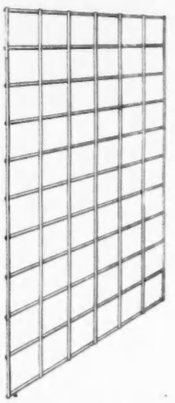

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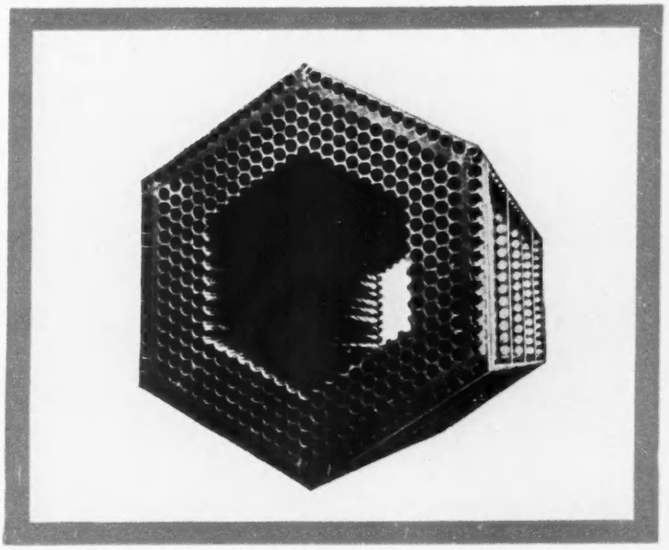

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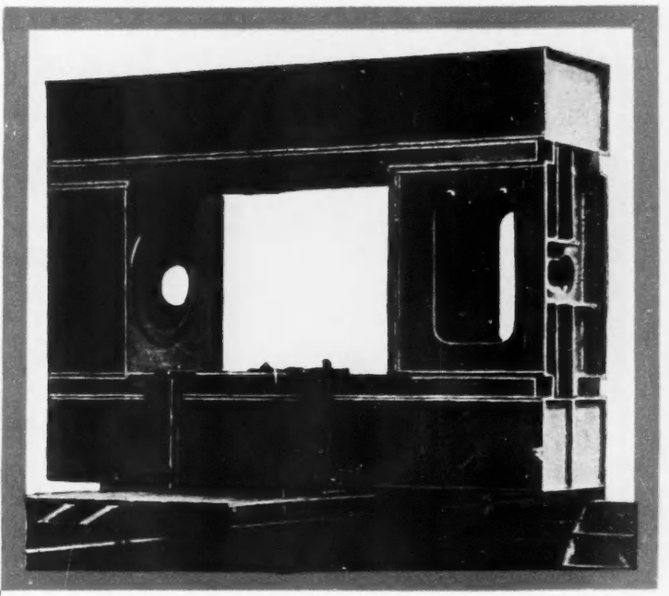

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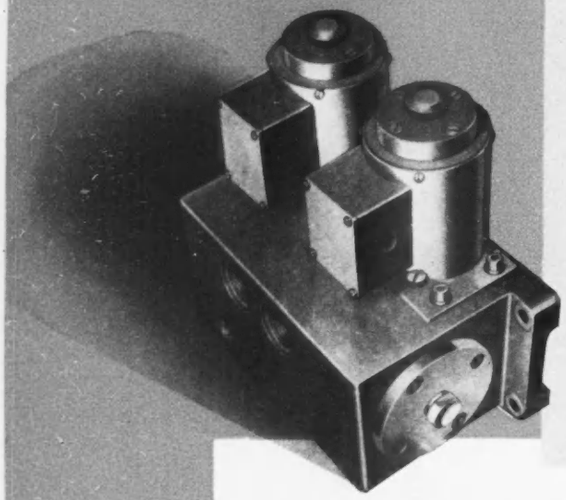

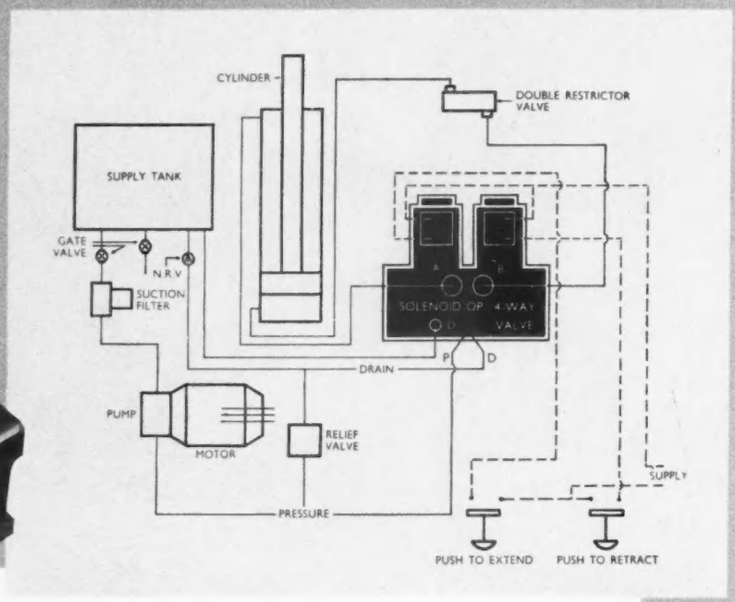


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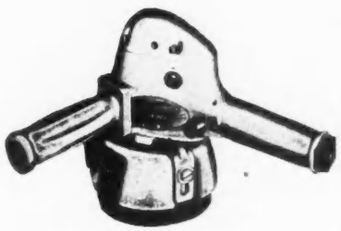

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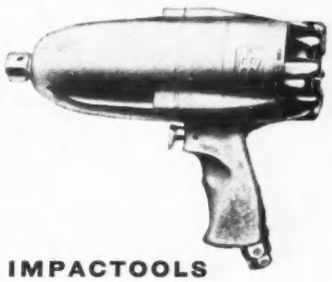

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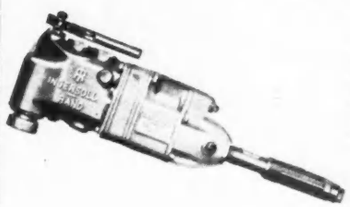

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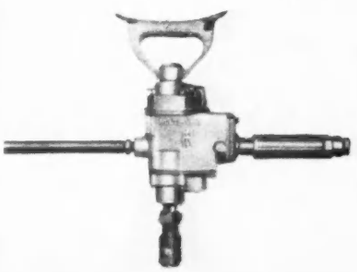

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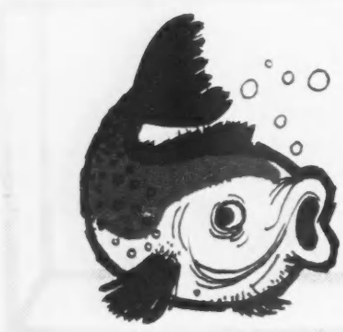

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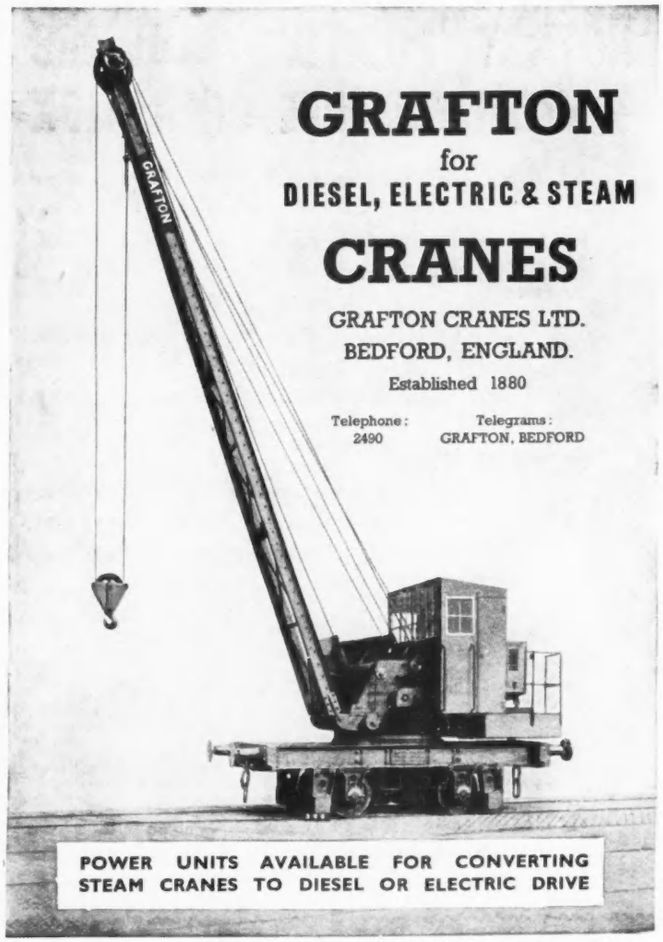


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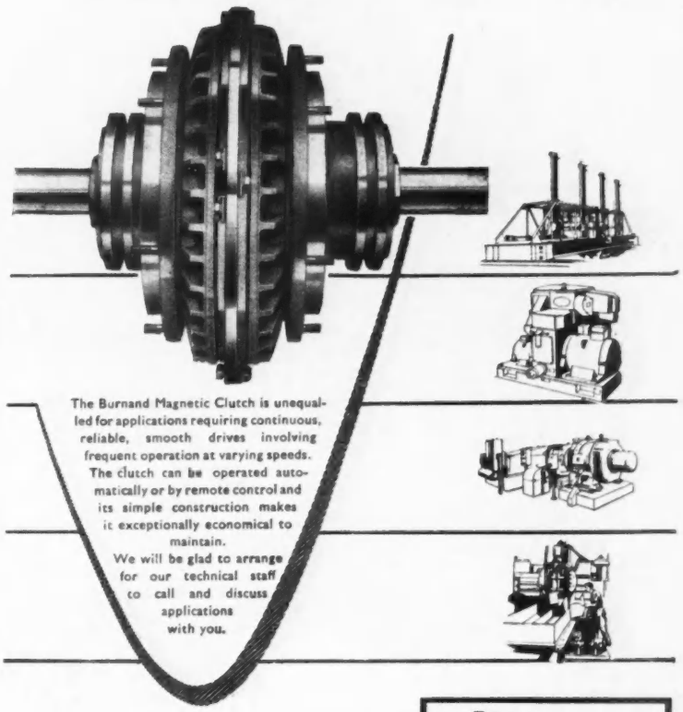

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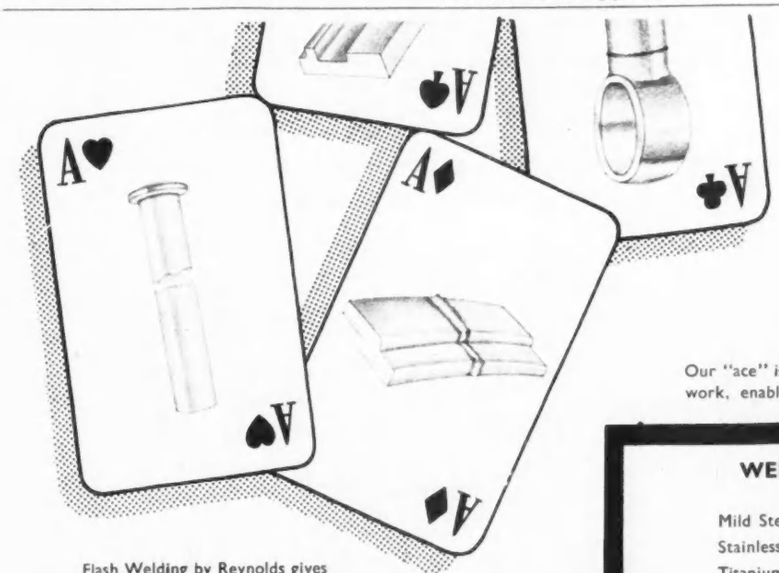

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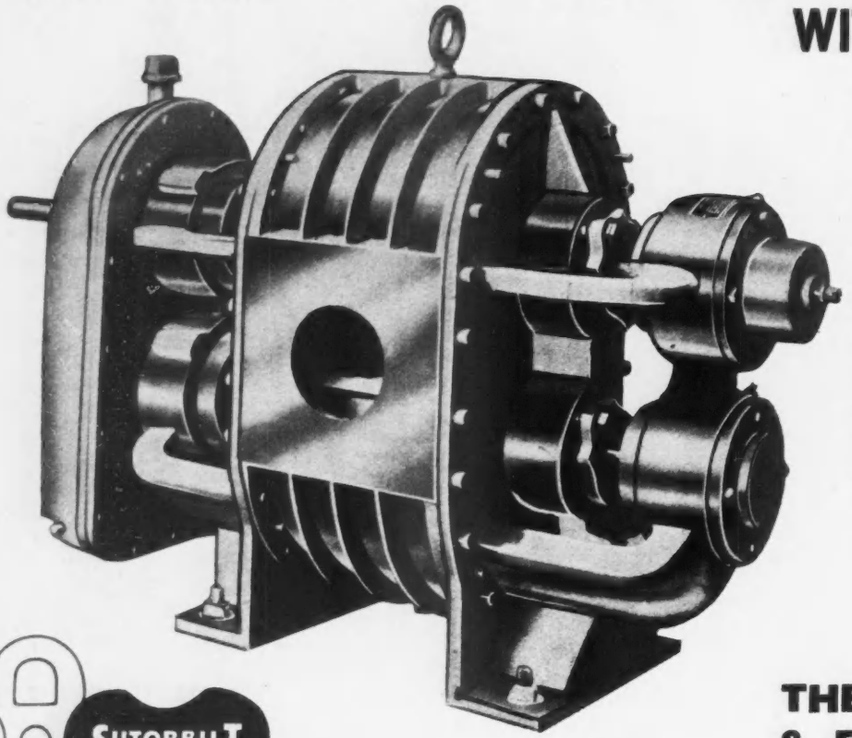

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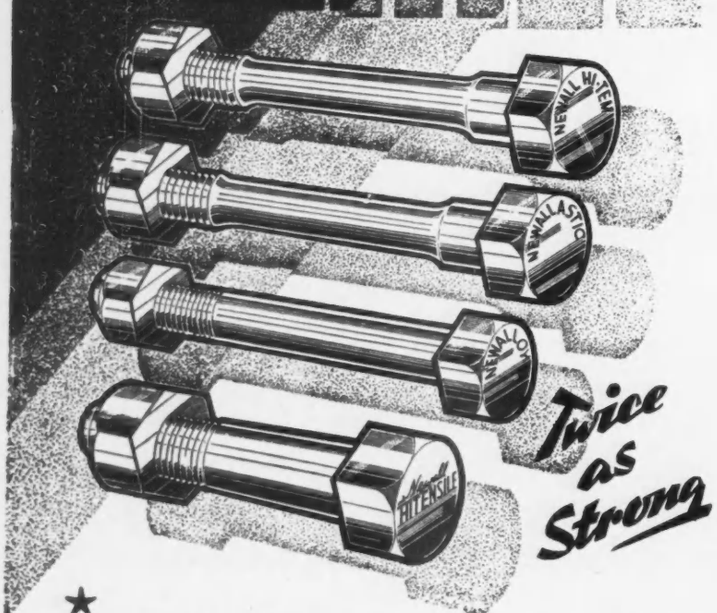


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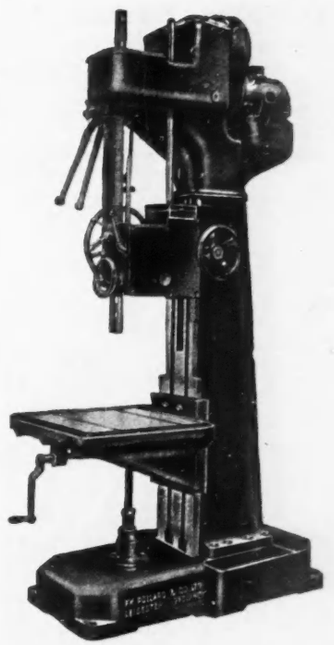

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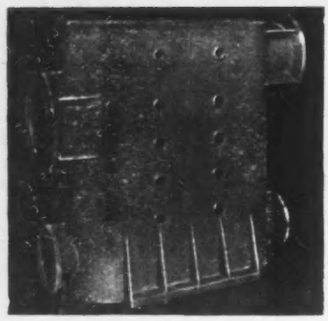

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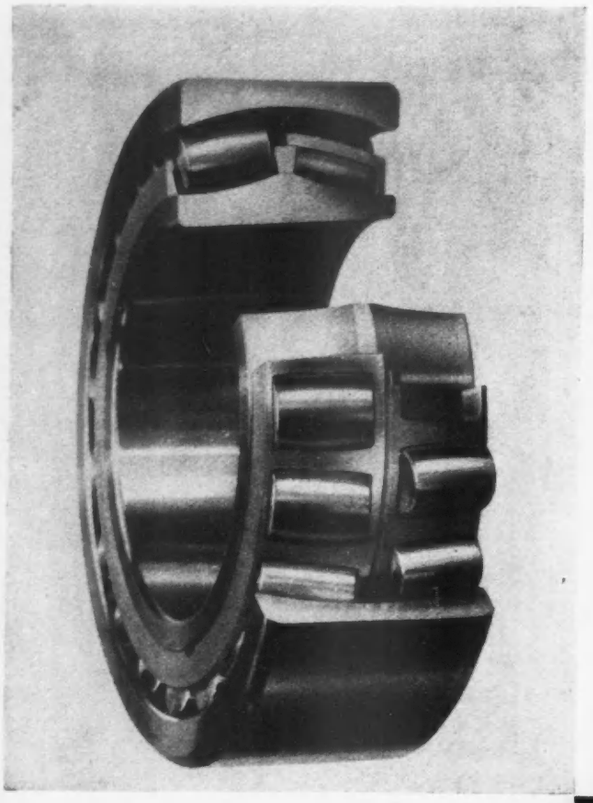

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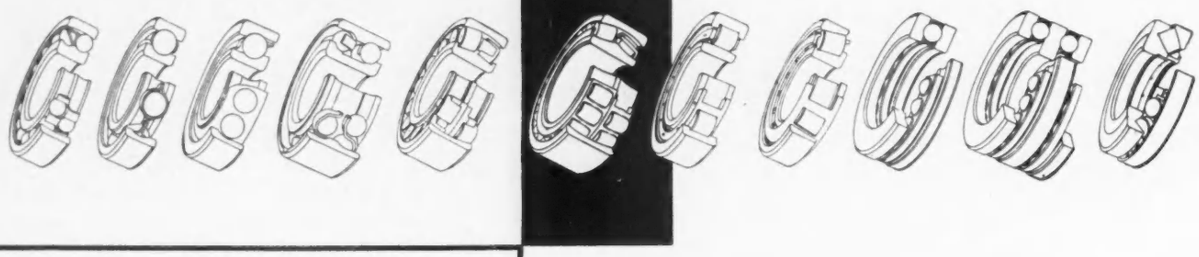

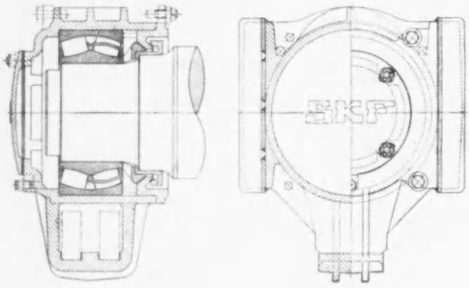

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# THE ENGINEER

No. 5420 DECEMBER 11, 1959 VOL. 208

## DISTRIBUTING INDUSTRY

Anyone who can spare the time and has the opportunity to take a " rural ride " to-day cannot fail to notice the increasing number of modern factories that are being established in country areas. Certainly, this steady distribution of industry does not seem yet to have made very much difference to the industrial conurbations, though it is bringing about a change, and in many cases, we believe, a change that is welcomed, in the British countryside. Until comparatively recent times the tendency remained strong to build new factories in those places which are commonly dubbed " industrial areas." In such places, it was asserted, industry could flourish even though much of it might be carried on in something akin to Blake's " dark Satanic mills." During the earlier years of this century, however, most of the " dark Satanic mills " were steadily replaced by establishments in which working conditions were continually improving. But those establishments frequently remained huddled together in down-town districts or on factory estates that rapidly sprawled across land which was well-nigh derelict ! The second world war started the change that is still going on. Factories had to be evacuated, industry had to be dispersed, manufacturing establishments to meet the many needs of the war effort had to be built and built quickly. Many such establishments were sited for strategic reasons in those parts of the country which had hitherto been considered as remote from urban amenities. Before the war ended, however, much thought was being given to the location of the industry of the future. The replanning and rebuilding of towns and cities had to be considered. The schemes for new towns, many of which are now approaching completion, were evolved and there was a general readiness to look at projects for relieving congested residential and industrial areas. One result of this kind of thinking and planning has been some schemes like that propounded and now being operated by the London County Council in co-operation with various provincial towns. This " town development scheme," as it is called, was described in our issue of April 3 last. The aim of that scheme is twofold. It is to relieve congestion in the L.C.C. area and to extend industry in those towns which are participating.

But there are some other proposals emerging from small country towns. They are proposals which can prove beneficial to some sectors of industry, especially some sectors of the engineering industry. One example, about which we have recently received information is a scheme for industrial development at Wem in Shropshire. Wem is a typical country town, the main business of which has hitherto been in catering for the large agricultural area by which it is surrounded. The industries which have been carried on there for generations are those closely allied to agriculture. Centralised marketing schemes and the development of road transport have, however, now diverted some of the former trade to larger towns, leaving scope for other kinds of industry in the area. The Urban District Council of Wem obviously has an eye to the future. It believes that the town can benefit from the infusion of a little industry different from that which is traditional in the neighbourhood. Accordingly, the council is prepared to encourage and assist, as far as it can, the provision of suitable factories within its area. No doubt, there are other towns besides Wem which are endeavouring to initiate similar schemes. They are places which, though retaining much of their rural flavour, are no longer in the back o' beyond. For their communications with long-established industrial centres, with seaports and with railway facilities are good. Moreover, they are places from which the youthful population tends to move away in the search for suitable employment. Some of these towns may be, in fact, in areas which could well be assisted by the provisions of the Local Employment Bill, the committee stage of which is in progress as we write. In its desire for well-regulated industrial development, the Urban District Council of Wem may quite likely be creating a valuable precedent. In industrial, as well as in purely social affairs, town and country can get nearer to each other to their mutual advantage.

## RATING OF ENGINEERING SOCIETIES

A number of engineering institutions will have been interested in a case recently before the Court of Appeal. It related to the rating of a scientific society. In March last year, over eighteen months ago, the Institution of Mechanical Engineers appealed to the Lands Tribunal against the decision of the Central London Local Valuation Court that it was liable to pay rates to the Westminster City Council. That Tribunal found that it should be exempt. The Council appealed from that decision ; and on Monday of this week the Court of Appeal reversed the decision of the Tribunal. The terms of its judgment were remarkably clear. Under Section 1 of the Scientific Societies Act, 1943, rating exemption is conferred in respect of " any land houses or buildings . . . belonging to any society instituted for the purposes of science, literature, or the fine arts, exclusively . . . occupied by it for the transaction of its business, and for carrying into effect its purposes, provided that such society shall be supported by annual voluntary contributions . . ." The appeal by Westminster City Council was granted on the grounds that the Institution was not formed for the purpose of science exclusively as in the opinion of the Justices the term mechanical engineering includes something more than the science of engineering in that it at least includes its practice and technique. There was the further question as to whether the Institution was supported wholly or in part by voluntary contributions. Because members are entitled to the society's publications and they also obtain the benefits of a society composed of professional men interested in the same subjects and deriving advantage from their corporate

studies ; and because it cannot be said in the view of the Justices that the subscriptions are in their nature altruistic the subscriptions of members of the Institution cannot be regarded as voluntary. The judgment also contained a sentence to the effect that in the circumstances it was unnecessary to consider separately whether the premises had been used by the Institution for purposes other than those set out in the Charter, matters having an important influence upon the findings of the Lands Tribunal.

Leave to appeal to the House of Lords was granted so the affair must be regarded as still *sub judice*. But in considering whether to carry the matter further the Institution will need to weigh up a number of rather imponderable factors. Despite the clarity of the judgment it may be felt that the Institution still has a case to argue. But it will also have to decide for itself what are the chances of the Government acting upon the recommendations of the Pritchard Committee whose Report on "The Rating of Charities and Kindred Bodies" was issued last August. If legislation were founded on that Report it is probable that all the major engineering institutions would be relieved of 50 per cent of their rates, at very little trouble to themselves. There is a point there which the Council of the Institution may wish to bear in mind. Throughout the protracted legislation so far the Council has had to weigh the saving of money in prospect if the Institution were relieved of rates against certain inconveniences bound to be suffered relating in particular to the restricted uses to which its building could be put and the restricted purposes for which it could expend any money once relief from rates had been secured. If the Government were to act upon the recommendations of the Pritchard Committee there might well result the satisfactory compromise that though there would not be full rating relief there would also be less restriction upon the activities of the Institution. The legislation might also be of such a character as to remove any hope that relief exceeding 50 per cent could be obtained. But will the Government act upon the Pritchard Report ? There needs also to be borne in mind the cost of continuing proceedings which must already have proved very expensive. Other Institutions will be interested to see what the Mechanicals decide to do.

## ANNUAL GENERAL MEETING OF THE GUILD

The Annual General Meeting of the Engineers' Guild was held at the Grosvenor Hotel, Victoria, London, last Wednesday. The year ended September 30, the Annual Report reveals, was a notably active one for the Guild. It began with the opening of Guild membership to members of the Institution of Chemical Engineers, and during the year control of the Professional Engineers Appointments Bureau was transferred to the Guild. It is never very easy for the Guild to convey in its annual report an adequate idea of the work it does since much of the work consists of advice and assistance to individual members. However, the value of the Guild is every now and then brightly revealed as, for example, when, as noted in the report which lies before us, it strongly criticised the Metropolitan Water Board for reducing the salary scales of the posts of Chief and Deputy Chief Engineer. The executive committee of the Guild resolved that it regarded the action taken by the Board "as indicative of the value placed by a public body on the services of professional engineers, and that the reduction of these scales below figures arrived at by an independent tribunal is unjustified and damaging to the profession and to the public interest." A more pleasing indication of the value of the Guild is provided by the information that arrangements for regular consultation with the British Transport Commission have worked so well over the last three years that a special panel has now been appointed to be responsible in future for all matters affecting the interests of members in this field.

Towards the end of the year there were published by the Guild details of a survey of earnings of engineers. It applies unfortunately to 1956, since when costs of living—and presumably salaries also—have risen quite substantially. But even allowing for that factor it shows a standard of remuneration which is surprisingly low. The standard is, in fact, so low that it has led some people to question whether the scarcity of engineers that is supposed to exist in this country really does exist. For if there really is a shortage should it not be reflected in higher salaries offered ? An alternative explanation which occurs to us is that the shortage lies in the classes of engineers which are more highly qualified—that is of Honours Degree standard and above. Young men entering the profession with high academic qualifications certainly seem able to command satisfactory starting salaries. There is the further relevant point that because academic standards demanded of candidates for membership of the major engineering institutions have been steadily rising some of the older members cannot any longer be regarded as really well qualified. It may well be that there are a sufficient number of such men, able now to command only low salaries, to depress the mean value of the curve relating age to earnings. The Guild expects to carry out another survey covering a more recent year. We hope the opportunity will be taken to break the figures down in ways likely to reveal whether such speculations have any truth in them. Possibly the Professional Engineers Appointments Bureau, out of its experience, could provide some enlightenment now.

## THE DISASTER AT FREJUS

The failure of Malpasset dam in Southern France, and the consequent devastation and loss of over 300 lives will now doubtless be familiar from the extensive reports in the daily press. Some details of the dam are given on page 774. The failure of a dam—and this one was of only moderate size—seems to have the possibility of bringing with it disaster on a scale unequalled by any other accident or failure of a purely man-made device. The heavy responsibilities which are borne by engineers in charge of the design or operation of large dams are doubly evident after such a tragic event, and all engineers must feel sympathy, not only for those who lost their lives at Frejus, but also for those concerned in designing and building Malpasset dam.

There have been quite a number of disastrous failures of dams in the past, but it would probably be a fair summing up to say that, with the rapidly advancing state of the art, most civil engineers would have thought until last week that recurrence of such failures to-day was highly unlikely if not impossible. Indeed, we believe the Malpasset dam may be the first arch dam to have failed, for this kind of dam, although slender and economical in material, is, in the opinions of some designers, a better solution theoretically, and possessed of greater reserves of strength, than other dams such as gravity or buttress designs. A report on the reasons why the dam failed will, therefore, be awaited with deep interest. No such report or technical explanation of the failure is available as we go to press. One other report, almost equally disturbing, should be mentioned, however. In *The Times* last Monday it was stated that ten "technicians"

had been indicted in Madrid for their responsibility in a disaster on January 9, north of Zamora, when a dam burst and caused loss of life in the village of Ribadelago. No details of the dam are given. In such cases of disastrous failure it is necessary that the full technical facts should be established and should be widely known, so that the reasons for the failure can be accurately assessed. Only in this way is the fullest insurance obtained against the possibility of other failures in the future, for the same set of circumstances can then be confidently eliminated in the design or construction of new works, or perhaps even detected, before failure, in a work already in existence.

## JOINT CONSULTATION

A few days ago we were privileged to see a preview of a new film which has been produced for the Electricity Council by R.H.R. Productions, Ltd., in association with the Film Producers Guild. It is entitled "Talking to Some Purpose." The object of the film is to explain to employees in the electricity supply industry the functions of the industry's joint consultation machinery at local level, and to serve as an aid in enlisting their active support for the work of their Local Advisory Committee. The Electricity Council has been notably successful in making joint consultation work. But one of its difficulties is to get the rank and file in the workshops and elsewhere throughout the industry really interested enough for them to discuss various matters with their local representatives. It is a major purpose of the film to appeal to the rank and file ; and it was our impression that it is very well fitted to do so.

Discussion after the showing of the film was very revealing of the way joint consultation develops. The first result of setting up a committee is often that it deals only with complaints about soap and lavatories, &c. There is, indeed, a danger at this early stage that it may develop merely into a "grumble shop." Much depends upon the chairman who, for the reason that most recommendations made by the committee must be implemented by management, is always drawn from the managerial side. The faith of the men in the new machinery can be built up only slowly. The Electricity Council has, however, found that after three or four years a sense of real partnership is built up and that really constructive suggestions come from the men's side. Furthermore, the machinery comes increasingly to be depended upon for conveying explanations from management to men as well as suggestions from men to management. We got the impression, indeed, that this form of consultation can be of great value in building up excellent industrial relations even in a very large organisation. We also gained the impression, however, that an unusual degree of patience and tact must be exhibited by those who organise the machinery. Few men have it. Therein, possibly, lies the explanation for the mixture of success and failure which has been the experience of the various industries and firms that have set up joint consultation machinery. There just are not enough organisers with the right qualities to go round !

## INSTITUTION DISCUSSIONS

Earlier this year, the Institution of Mechanical Engineers announced that it had been considering again the method of conducting the discussions at its ordinary meetings. Its statement on the subject made the very pertinent point that those who participate in a discussion at an institution meeting "bear a special responsibility to ensure that they have something of significance to say." After studying the "Mechanicals" pronouncement, we were moved to suggest, in our issue of April 10 last, that some thought might well be given to the desirability of devising instruction courses in "technical talking." It is by no means easy to develop the art of communicating thoughts, ideas or criticism in speech at any kind of public meeting, formal or informal. But it is important that engineers, like those in other professions, should endeavour to express themselves in such a way that all who wish to do so will be glad to hear them ! We have therefore learned, with a good deal of pleasure and no little satisfaction, that the suggestion which we offered has been discussed in greater detail at a recent conference of chairmen and honorary secretaries of the I.Mech.E. Graduate Sections. At the conference, it was revealed that several members of the Yorkshire Graduate Section are taking an appropriate course at present being held in Sheffield. Another suggestion put forward at the conference was that technical colleges might well be able to help by making provision for courses in "technical talking." The Institution intends to "explore this possibility." We are confident that the time and effort called for will not be wasted. The value of Institution discussions can undoubtedly be greatly increased by the logical presentation of the thought of those who contribute to them. We look forward to fuller development of the idea.

## The Engineer—100 Years Ago (DECEMBER 9, 1859)

"SCOTTISH MATTERS"

"A lecture has been delivered at Glasgow, by Colonel Shaffner, of America, giving the results of his investigations and discoveries in his recent surveying voyage to Labrador, Greenland, and the Northern Seas, with the view of deciding the practicability of forming a telegraphic communication by that route to America. After declaring that his aim was not to organise a company or to dispose of stocks, Colonel Shaffner said that he was satisfied, from a full consideration of the subject, that the telegraph from Ireland to Newfoundland could not be practically consummated for commercial purposes. Having this conviction, he had set himself to think on the subject, and the result was a belief that the more feasible route was by Labrador, Greenland, Iceland, the Faroe Islands, and thence to Scotland. He had obtained from the Danish Government a royal concession for the exclusive possession of Greenland, Iceland and the Faroe Islands, having in view the formation of telegraphic communication between Europe and America for 100 years, and he hoped that within another year the whole thing would be completed.

"On sounding the seas between Labrador and Greenland and Greenland and Iceland, he found there was a beautiful bottom throughout all—a soft bottom, with not the slightest appearance of volcanic action ; on the contrary, the sea gradually descends from Labrador to within 100 miles of Greenland, starting with 90 fathoms, and terminating with 2,090 fathoms. Such was the character and depth of the bottom. There were no insuperable difficulties in carrying the line from Hamilton's Inlet, Labrador, to Quebec. On the side between Greenland and Iceland he was apprehensive that he would find deep cavities and volcanic mountains. Contrary to expectation, the ocean was of the same bottom as in the whole basin of the Atlantic between Ireland and Newfoundland, and all over the Northern Sea."

# St. Lawrence River Development

## XI—International Rapids

*The United States' section of the St. Lawrence Seaway is described here. It consists of two locks, about 10 miles of canal and various other works. We also conclude our account of the International Rapids section of the power and navigation projects with notes on the very extensive works needed for channel improvement, to rehouse people displaced by flooding the "power pool," and to re-establish road and rail communications.*

THE United States' Seaway—that is the navigation works which by-pass the 83ft head of the St. Lawrence generating station on the U.S. shore of the river—was shown in the map, Fig. 31, which we published with Part IX of this series. It will be recalled that these works consist principally of two locks, separated by about 3 miles of canal, with further canal works upstream, making about 10 miles of canal in all, and river excavation downstream from the lower lock to complete the south shore navigation route.

Practically all of these works, with the exception of the last named, were constructed "in the dry," clear of the natural river channels, and were flooded when the "power pool" was raised. Thus, the canals now extend through lakes, and the extent of the flooding had to be limited by constructing embankments around the lock heads and along the river bank.

The upper lock of this section is known as Eisenhower lock, and the lower one as Snell lock. The canal is called the Wiley-Dondero canal. Since most of the construction was carried out in open country, the work was straightforward and not so complex as the work at some of the Canadian sites described earlier.

The Eisenhower and Snell locks are generally similar to the locks of the Canadian Seaway, which we have described already, so here the main aim is to emphasise points of difference in the two cases. The general layout and standard dimensions of the two U.S. locks are, of course, the same as for the Canadian locks and the controlling dimensions for the canals are also the same. The heads are 42ft for the Eisenhower lock and 40ft for the Snell lock. The walls of both locks are of gravity section and were built in 5ft lifts with climbing shuttering, without any of the elaborate forms such as were used at Beauharnois, for instance, thus following the same trend in concreting as described last week in the construction of the power house. A 10ft lift was allowed if the cross section did not exceed 16ft in width, but in all cases a 120-hour delay between successive lifts was stipulated for the Eisenhower and Snell locks.

Both locks are controlled by mitre gates, with one pair of gates at each end of each lock; the sector gates characteristic of the Canadian locks have not been used by the Seaway Development Corporation. Only one of the locks—the upper one—has a guard gate. This gate is a vertical-lift gate which is normally housed in a slot below the sill level at the upstream end of the lock. This rather unexpected design was adopted because a road tunnel was built under the upstream approach of the lock, so the gate slot and tunnel could be built together. The provision of only one guard gate for two locks is less than for the Canadian installations but in this case there is a wharf for storage of spare gates where a 300-ton barge equipped for lifting the gates and a tug are kept. This wharf is just below the Snell lock, since the gates have to be handled from downstream. There is also a maintenance base between the two locks, the facilities of which include an emergency berth for a large vessel. Port developments are expected along this length of canal.

The guard gate at Eisenhower lock is 80ft wide by 46ft high and is a single-skin gate, bearing through rollers fixed to the gate. It has rubber seals at the sides and sill. The lifting mechanism consists of two hydraulic cylinders, which are housed with their associated motors and gear below the level of the lock invert. The gate is lifted at a speed of 2ft per minute.

Hydraulic tests were carried out to ascertain the loads on the gate when it was raised, against the maximum possible flow, and to investigate generally this procedure, since it was necessary to know, for instance, whether air vents would be needed in the gate, at what height the gate ceased to act as a submerged weir and free overfall was induced, and what would be the down thrust on the gate due to the water flowing over it when this stage was reached. Broadly favourable results were found from these tests, and the gate's duty is not unduly severe. No special vents were needed and the down thrust is equivalent to a 3ft column of water over the area of the top of the gate. Pressure distribution follows closely the linear variation of hydrostatic pressures, except that on the upstream face the pressure on that part of the gate still contained in the gate slot is much reduced.

At the Snell lock there are no bridges or tunnels, but the design allows for a swing bridge to be built at the upper end. Equipment at the two locks follows similar lines to the Canadian locks. However, gate fenders are used rather than bascule fenders above and below each gate. A more basic difference in design is in the culverts and ports for filling and emptying.

Excavation for the Wiley-Dondero canal was in glacial till for about two-thirds of its length at the upstream end, and in marine clay at the downstream end. The clay was unsuitable for embankment construction and at the lower lock the excavation had to be sloped at 1 in 12 to prevent slips. The earthworks here were very extensive and included nearly 4 miles of embankments, the maximum height of the embankments being about 45ft.

The intermediate channel between the two locks has a controlled water level of 200ft. A surge, reducing the level by nearly 2ft, was considered possible due to filling the Snell lock. A −2·5ft surge was fixed in design, to allow for the coincidence of a surge due to wind and a surge due to locking.

At the upstream end of the canal, a great deal of attention was given to fixing the position of the canal entrance. For instance, it has to be easily found by vessels travelling downstream, possibly in fog, which have sailed over 17 miles of open water from Iroquois.

For the purely U.S. length of the Seaway, the St. Lawrence Seaway Development Corporation appointed the U.S. Corps of Engineers to carry out design and supervise construction.

### Cornwall Island Bridges

In the original plans for the U.S. Seaway, the New York Central Line's railway, which crossed the two channels of the St. Lawrence at Cornwall Island on dual road/rail bridges, was to be diverted from the south channel, where the Seaway now passes, to the Snell lock. The lock was to have been crossed on a swing bridge, for which allowance has been made in the design of the lock. Then the railway would have rejoined its original route on Cornwall Island. The international road crossing would have followed the same diversionary route to the Snell lock swing bridge. This plan involved two subsidiary bridges and over 5 miles of new road and rail route.

In 1956 it was decided to abandon the international rail link, and it then became possible to proceed with the construction of a high-level suspension bridge, giving the stipulated 120ft headroom for navigation over the south channel, to carry the international highway. This bridge was built jointly, the Seaway Authority being responsible for the substructure and the Development Corporation for the superstructure. It was completed and handed over to the Cornwall International Bridge Company last December. The bridge has a main span of 3840ft and a total length of 5000ft. The carriageway is 27ft wide, with a 4ft pavement, the approaches being on a gradient of 4 per cent. The consultants and contractors for the bridge were respectively D. B. Steinman and the American Bridge Company for the superstructure and the late Dr. Pratley and the McNamara Construction Company, Ltd., for the substructure. The Roosevelt International bridge, which was about 1300ft downstream, was previously demolished and, during the summer of 1958, a ferry service was used temporarily.

The new international highway route is to be completed on the Canadian side by a high-level bridge across the north channel from Cornwall Island to the mainland. This bridge is due to be completed in 1961. The bridge will be about a mile long, with thirty-three steel continuous truss spans carrying a 27ft roadway. The consulting firm for the bridge is again H. L. L. Pratley, with whom Foundation of Canada Engineering Corporation, Ltd., is associated for the design of the substructure. The superstructure contractor is the Canadian Bridge Division of the Dominion Steel and Coal Corporation, Ltd. The principal substructure contractor is C. A. Pitts, Ltd., but part of the substructure is being built by Canadian Bridge, Ltd.

(formerly Sir Lindsay Parkinson (Canada), Ltd.).

### Re-routing Communications and Rehousing

Apart from the Cornwall bridges, very extensive re-routing of roads and railways has been necessary along the shores of the "power pool," especially on the Canadian side. Fig. 31, published with Part IX, showed the old and new routes on both sides of the border. On the Canadian side, new construction involved about 40 miles of main line railway and about 35 miles of main highway, with considerable work on re-routing transmission lines and other public utility services as well. On the U.S. side, over 10 miles of new highway was built, apart from the diversions to the tunnel at Eisenhower lock.

A more serious aspect of the reservoir flooding was, however, the re-establishment of the homes of about 6500 people on the Canadian side of the river. This entailed the repositioning of the village of Iroquois and part of the town of Morrisburg, and also of six hamlets. The area affected was about 20,000 acres.

A feature of the work was the transporting of houses bodily from their old sites to the new ones. The area was one of early settlement and many of the properties within the "power pool" were considered to be of special interest and worthy of preservation. About 550 houses were moved during the three years that the rehabilitation programme was in progress.

Originally, house-moving was done with two Hartshorne machines, winch trucks and house-moving dollies. Houses up to 150 tons in weight were handled by the larger of the two machines. Each machine operated independently, picking up a house in the old town, moving it to the new site and placing it over the foundation. Due to the width of these machines, however, access roads 45ft to 50ft wide were needed between the two locations. At Iroquois this amounted to less than a half of a mile and was not a serious problem, but elsewhere a different technique was developed.

A house-moving trailer was designed and fabricated which would carry a 100-ton house and which could travel on conventional roads. This trailer was fitted with a removable goose-neck and had the rear tyres and axle units spaced to 21ft widths to make full use of the existing roads and at the same time stabilise the load. Using this trailer, one house-moving machine was stationed in the old town and one in the new. One house-moving machine lifted the house from its foundation and placed it on the trailer for transport to the new town, and the second machine removed the house from the trailer and placed it on the new foundation. During the summer of 1956 an average progress of almost two houses a day was maintained. The trailer is shown in Fig. 40 and the Hartshorne mover in Fig. 41.

### Channel Improvements

Little has been said about the vast amounts of dredging and excavation in the International Rapids section, or about the construction of the many miles of embankments which enclose the power pool on each side of the power house, and in the region of the locks and the Wiley–Dondero canal. However, the total quantities involved as quoted in Table III in Part I of this series alone are sufficient to appraise the vast amount of work involved, merely in the earth-moving side of the scheme.

Construction of the embankments followed much the same general lines as was described in Part II of this series for the Lachine section, and similar materials were involved. In the river works, successful dredging or excavation of the improved

**Fig. 40—Heavy trailer adapted for house moving**

channels to the limits specified was especially important at one or two critical reaches, as was made clear in the earlier description of the hydraulic model investigations.

The first of these critical areas was the Galop Rapids, where river velocities were up to 14ft per second before the new works were started. In the later stages of this work, Iroquois barrage was brought into use to allow gradual raising of the water level upstream from the barrage, to keep pace with the progress of channel enlargement at the Rapids. Another critical area was in the Cornwall Island reach, where the cross-channel Pollys Gut was discharging about two-thirds of the river flow at high velocity into the south channel (see Fig. 31) where the flow had to make a 90 deg. turn, just clear of the future entrance of Snell lock. Enlargement of the south channel to meet the 4ft per second limiting velocity for navigation, compensatory dredging in the north channel, and training banks in Pollys Gut, solved this problem.

Generally, the alignment of the improved navigation channels was selected to avoid changes in direction and cross-currents as far as possible. The outsides of curves were defined by straight lines, and the inside of the channel widened by 10ft per degree of change in direction. In fixing the dredged depth of the channels, allowance was made for loose rocks on the channel bottom, and for river surges due to wind.

Canadian contractors for channel improvements and dredging in the International Rapids were the McNamara Construction Company, Ltd.; Marine Industries, Ltd.; C. A. Pitts Contractor, Ltd.; John Entwistle; and the Canadian Dredge and Dock Company.

### Pool Raising

The 14ft canal system was kept in use in the International Rapids section of the St. Lawrence through the constructional period. After Iroquois barrage and lock were completed, the reach upstream was gradually raised in level, as we have already explained, and at this stage Iroquois lock was brought into use, against a head of 23·5ft.

Below Iroquois, however, the river remained unaffected as far as navigation was concerned, until the stage of "pool raising" was reached. It was considered that this operation should be carried out as quickly as possible, to give the minimum interruption to river traffic. The total capacity of the power pool is about 575,000 acre-feet, which is not enough to affect the level of Lake Ontario seriously, so a rapid filling was envisaged, whilst still maintaining adequate flow downstream.

The 14ft canal passed through the embankment on the Canadian side of the power

**Fig. 41—The Hartshorne house moving machine**

house at a massive "closure structure" built in reinforced concrete to take stoplogs which span right across the old canal. These stoplogs were placed in position at midnight on July 1, 1958, navigation between Prescott and Cornwall having been stopped at 4 a.m. on June 30. At the same time the gates of the new Massena intake were closed. At 4 a.m., the gates at Iroquois barrage were opened to pass a flow of 310,000 cusecs, and two hours later the ground sluices at Long Sault dam were progressively closed.

At 8 a.m. on July 1, the cofferdam between Sheek and Barnhart islands, which had served to dewater the area on the upstream side of the power house, was breached by blasting. A second cofferdam at Ogden Island (Waddington) which closed off a length of newly excavated navigation channel, was also breached. By July 4 the "power pool" was full, and navigation was resumed using the new U.S. Seaway, after an interruption of only five days.

Subsequently, the cofferdam on the downstream side of the power house was progressively removed, and work at the power house advanced sufficiently for the first sets to generate power by July, 1958. However, the official opening of the power house, by H.M. the Queen and Vice-President Nixon jointly, was on June 27 this year. It is expected that all thirty-two of the generating sets will be installed and everything completed by the end of this year.

### Thousand Islands Section

Above the extensive engineering works of the International Rapids, construction of the Seaway was limited to improving, by dredging, the 25ft navigation route already in use. Thus the depth has been increased to 27ft, and the minimum widths of channels to 450ft in restricted reaches, but with widths of 500ft to 700ft in open water. Most of this work was rock excavation. It was the joint concern of both the Seaway agencies, but was in fact carried out under the control of the U.S. Corps of Engineers. One other associated work is the construction of a high-level suspension bridge between Ogdensburg and Prescott, which is now nearing completion.

*(To be continued)*

# 1000 H.P. Diesel-Electric Locomotive

By O. S. NOCK, B.Sc., M.I.C.E., M.I.Mech.E., M.I.Loco.E.

*As the first main line diesel-electric locomotive to be completed under the British Railways modernisation plan, No.* D8000 *is a machine of particular interest and importance. In this article the author comments upon a series of tests carried out on the London Midland Region during July, August and September,* 1958, *and published by the British Transport Commission.*

THE "Type 1" 1000 h.p. locomotives were primarily intended for freight service and particularly for short haul freight transfer workings, as between the principal yards of the different regions of British Railways in the London district. On such duties, due to the intricacies of the interconnecting routes and the density of traffic flowing on lines that conflict at many of the junctions, the time the locomotive is under power is small compared with the journey time, and considerable economies are to be realised by a change from steam to diesel operation due to the virtual elimination of stand-by losses. The "D.8000" class is, however, designed for general utility service, and has a maximum speed of 75 m.p.h. It is thus available for passenger service, and in determining the performance characteristics a number of tests were carried out using trains of passenger stock. As usual with tests conducted under the auspices of the Locomotive Testing Joint Sub-Committee, the performance and related fuel consumption of the locomotive were determined over its working range, and the results are presented in the bulletin in such a way as to enable train schedules to be calculated.

### The Locomotive

The actual unit tested, No. D.8000, was the first of the class, built in 1957. It had run 18,650 miles before road testing began, and ran a further 2240 miles during the tests. Power is supplied by an English Electric type 8SVT, Mark 11 engine, which has eight cylinders arranged in "V" formation. The engine operates on the four-stroke cycle, and is pressure-charged from two Napier exhaust-gas turbo-chargers. The main generator is bolted solidly to the engine bearers. The free end of the crankshaft is extended to provide a drive to the radiator fan. The output of the engine is determined by the position of the driver's controller operating pneumatically on the engine governor. The speed of the engine and its corresponding output is infinitely variable between 450 and 850 r.p.m. The controls are duplicated to enable the locomotive to be driven from either side of the cab.

From the main generator, power is fed into four traction motors connected in series-parallel. The traction motors have three

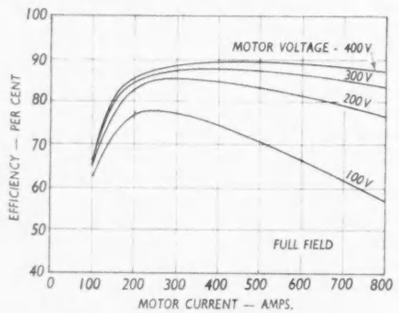
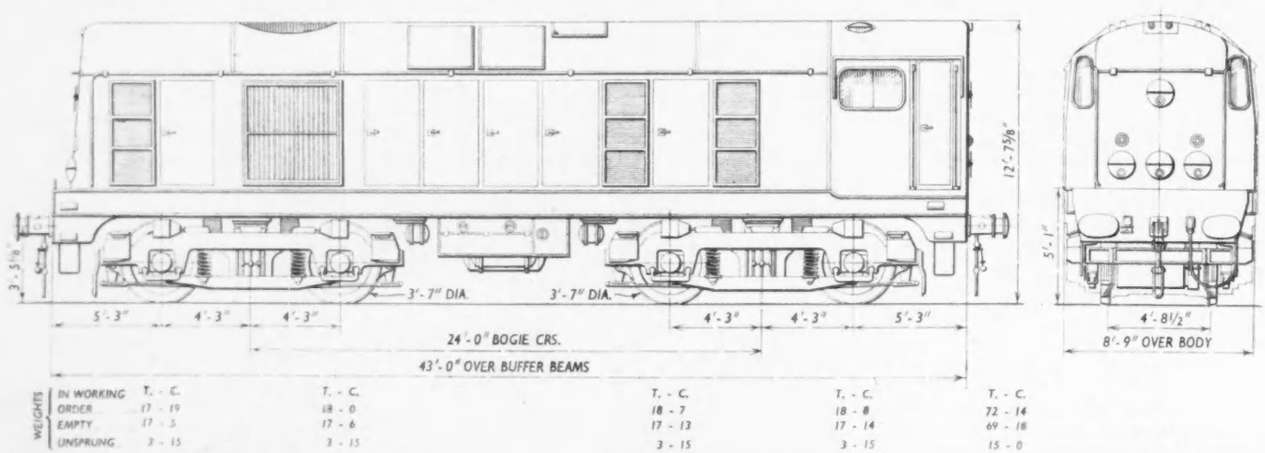



**Fig. 2—Designed motor efficiency**

stages of field weakening, and the gear ratio of 63 : 17 permits a maximum speed of 75 m.p.h. All auxiliaries, with the exception of the radiator fan, are driven from power supplied by the auxiliary generator, which is overhung from the free end of the main generator. The main generator excitation is also supplied by the auxiliary generator, and a torque regulator in the main generator field circuit is automatically adjusted by the engine governor loading to the available engine horsepower. When running at 450




| WEIGHTS | T. - C. | T. - C. | T. - C. | T. - C. | T. - C. |
|---|---|---|---|---|---|
| IN WORKING ORDER | 17 - 19 | 18 - 0 | 18 - 7 | 18 - 8 | 72 - 14 |
| EMPTY | 17 - 5 | 17 - 6 | 17 - 13 | 17 - 14 | 69 - 18 |
| UNSPRUNG | 3 - 15 | 3 - 15 | 3 - 15 | 3 - 15 | 15 - 0 |

**Engine** ... English Electric diesel—type 8 SVT., Mark II
8 cylinder, 4 stroke
With pressure chargers
1000 h.p. at 850 r.p.m.

**Main generator** ... English Electric—Type EE 819/3C

**Traction motors** ... English Electric—Type EE 526/5D
4 motors
Rubber-mounted nose suspension
Single reduction gear drive

**Performance** ... Maximum tractive effort 42,000 lb at 26 per cent adhesion. At 18,000A (main generator)
Continuous tractive effort 19,500 lb at 14·8 m.p.h. At 1000A (main generator)
Rail h.p. at continuous rating, 770 h.p.
Full engine output available between 5 and 75 m.p.h.

**Braking** ... Type:
For locomotive vacuum controlled air brake and direct air brake
For train vacuum braking
Brake force 82·5 per cent of locomotive weight in working order

**Speed** ... Maximum permitted service speed, 75 m.p.h.

**Curve** ... Minimum radius curve without gauge widening, 3½ chains

**Train heating equipment** ... Not fitted
Through steam pipe provided

**Tank capacity** ... 400 gallons

**Fig. 1—Type 1, 1000 h.p., $B_0$-$B_0$ diesel-electric locomotive**

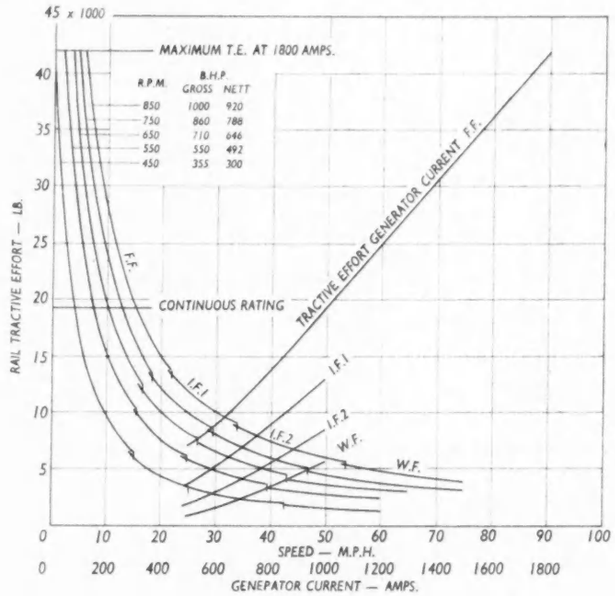
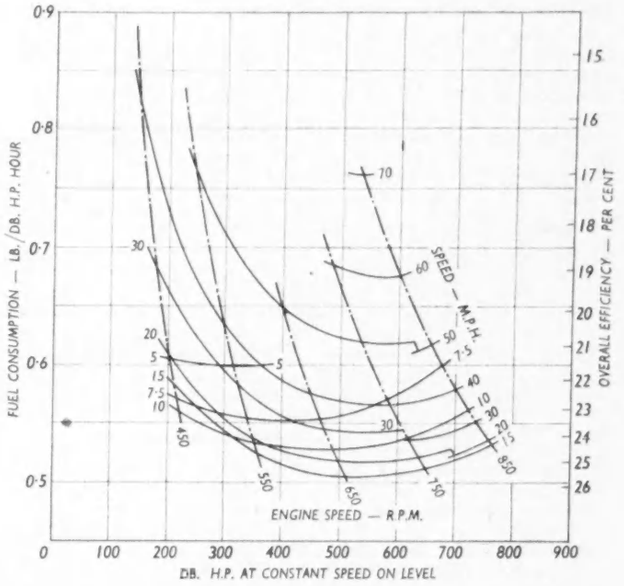



Fig. 3—Designed rail tractive effort characteristics




G.C.V. of fuel—19,710 B.Th.U. per pound.

Fig. 5—Fuel per drawbar horsepower hour

r.p.m., the minimum permissible engine speed, further reduction in power is obtained by progressively reducing the main generator excitation. A general view of the locomotive, with overall dimensions, is given in Fig. 1.

In addition to the general particulars given below Fig. 1 the locomotive can be used in multiple working with the following seven types of diesel-electric locomotive now working on British Railways.

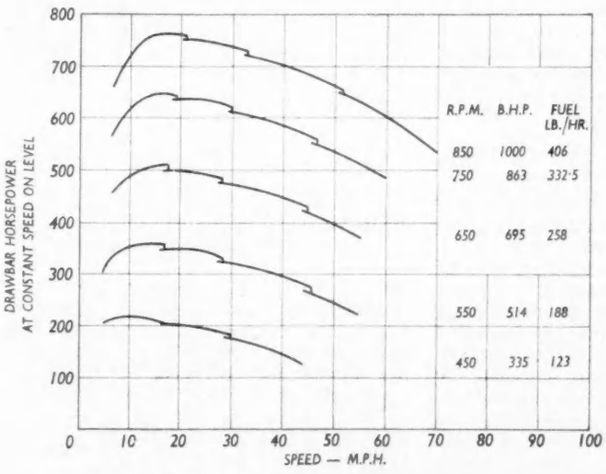
| Design | Wheel arrangement | Power type |
|---|---|---|
| L.M.R. 1160 h.p. ... ... ... ... | $B_0—B_0$ | 2 |
| L.M.R. 2300 h.p. ... ... ... ... | $1C_0—C_0 1$ | 4 |
| B.R.C. and W. 1100 h.p. ... ... | $B_0—B_0$ | 2 |
| E.E. 1100 h.p. ... ... ... ... ... | $B_0—B_0$ | 2 |
| E.E. 2000 h.p. ... ... ... ... ... | $1C_0—C_0 1$ | 4 |
| E.E. 1000 h.p. ... ... ... ... ... | $B_0—B_0$ | 1 |
| B.T.H. 800 h.p. ... ... ... ... | $B_0—B_0$ | 1 |

## Method of Testing

Prior to the road trials, the locomotive was subjected to static load tests at the Derby Locomotive Works Test Plant. It was found that there was a degree of hunting of the torque regulator, which gave rise to a fluctuation in current considered to be excessive for road testing purposes. There was also a certain disparity between the various cylinder peak pressures and exhaust temperatures. These matters were given the necessary attention prior to commencement of the road trials, which were then carried out on the route Toton–Leicester–Rugby–Market Harborough–Derby–Toton. The range of power output was investigated by conducting tests at five different settings of the controller, corresponding to nominal engine speeds of 450, 550, 650, 750 and 850 r.p.m. At any given controller setting, engine speed, brake horsepower, and fuel consumption remain substantially constant, and all test measurements were made under these conditions. The first setting, at the minimum engine speed of 450 r.p.m., was selected to give the minimum power available with torque regulation. Full power is given at the maximum engine speed of 850 r.p.m.

So far as practicable, each of these controller settings was maintained for the whole of a particular test run. Two or more runs at each setting were required to cover the range of road speed of the locomotive, that is, from 5 to 70 m.p.h. It was not found possible to exceed 70 m.p.h. during controlled tests, due to the absence of steep falling gradients on the test route. The first fifteen to twenty minutes of each run were devoted to warming up under conditions approaching those of a test. A graduated quadrant was attached to the controller to enable the setting to be reproduced on later test runs. During each test the Mobile Test Units were employed to control the road speed in suitable increments, that is of 5 m.p.h. at the higher and 2½ m.p.h. at the lower speeds. The normal period for which each of these constant speed steps was held was from ten to fifteen minutes, according to circumstances. Throughout each test, continuous records of speed, drawbar tractive effort, and so on, were made on the Amsler recording table in the dynamometer car. Fuel consumption was measured by means of a precision grade displacement type flowmeter recording electrically on the Amsler table in 1–10 gallon increments. The layout of the fuel system was such that fuel consumption could be readily obtained from measurements on one flowmeter. The current and voltage measurements were recorded by readings at one minute intervals on the electrical instrument desk in the dynamometer car, thus : main generator current ; main generator voltage ; main generator field current ; auxiliary generator current ; auxiliary generator voltage ; auxiliary generator field current ; engine revolutions per minute.

The main generator output readings were supplemented by results from continuous




G.C.V. of fuel—19,710 B.Th.U. per pound.

Fig. 4—Drawbar horsepower characteristics

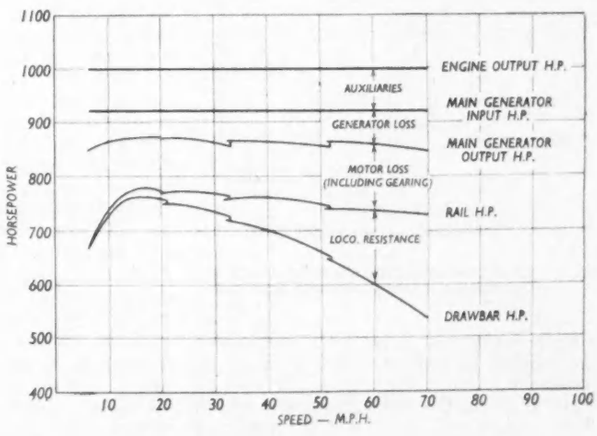



Fig. 6—Power distribution at 850 r.p.m.

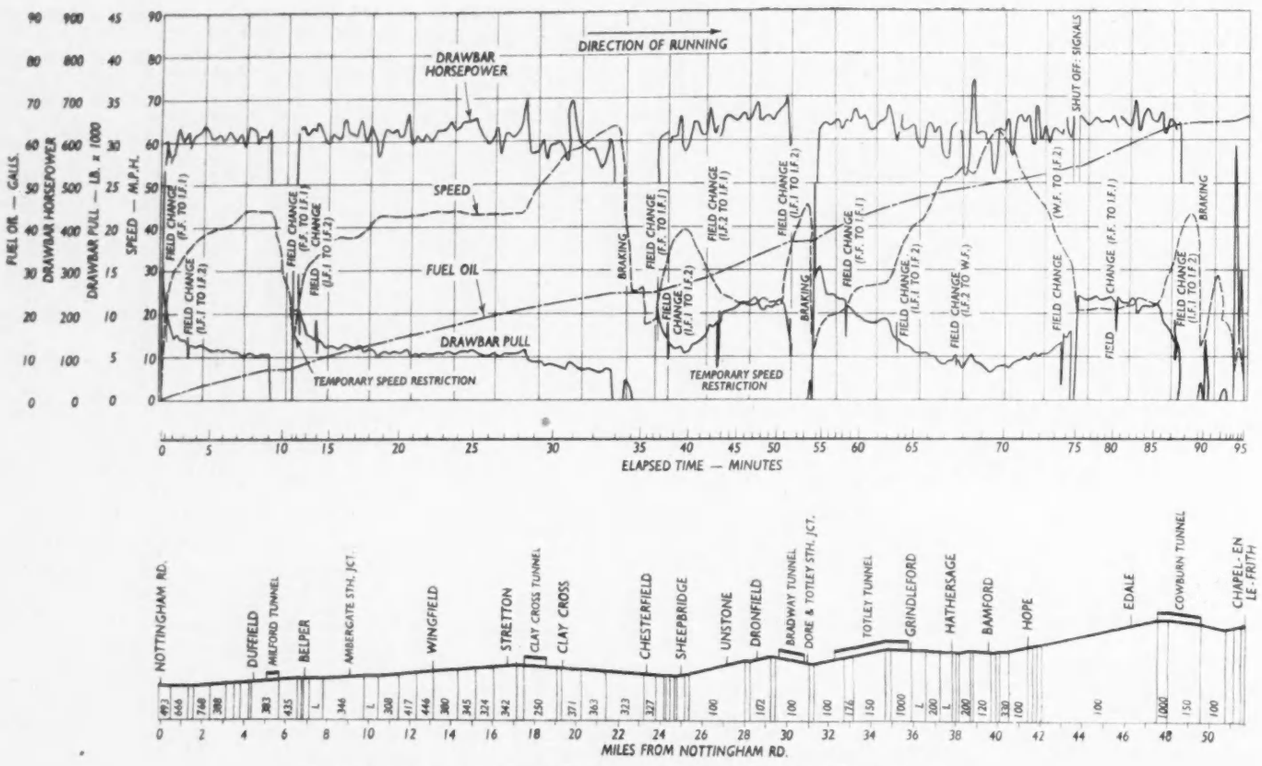
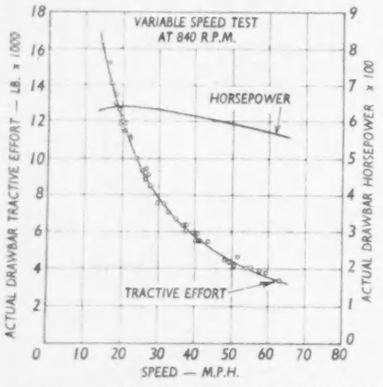



**Fig. 7—Example of test run with 542 tons trailing load—full controller—840 r.p.m.**

current and voltage recorders located on the instrument desk, and these instruments were also used to record the field changes.

The following additional measurements were made by test gauges in the locomotive cab: fuel temperature; fuel pressure; temperature of cooling water leaving engine. These readings were taken in synchronism with the observations in the car.

In order to demonstrate the practical application of the test results to normal service conditions, a run was made with a load of 452 tons (fifteen coaches including dynamometer car) to timings estimated from the performance characteristics previously established. The test route was Toton – Derby – Chesterfield – Chapel-en-le-Frith–Ambergate–Toton. The locomotive was worked at maximum power as far as practicable. As in the case of the tests at constant speed, the fuel consumption of the diesel engine and the electrical output of the main generator were continuously recorded in the dynamometer car.


VARIABLE SPEED TEST AT 840 R.P.M.
HORSEPOWER
TRACTIVE EFFORT
ACTUAL DRAWBAR TRACTIVE EFFORT — LB. x 1000
ACTUAL DRAWBAR HORSEPOWER x 100
SPEED — M.P.H.

Points from variable speed test shown on Fig. 7 (acceleration only).

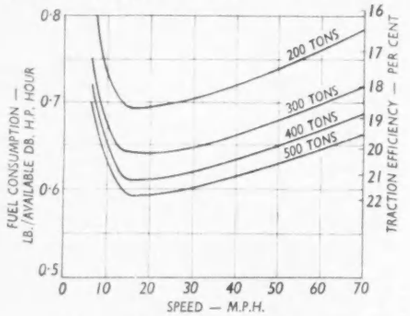
**Fig. 8—Actual drawbar tractive effort and horsepower characteristics obtained with 452 tons load**

## Control System of Locomotive

Appreciation of the test results contained in the bulletin, some of which are extracted in this article, will be the greater if the control system of the locomotive is clearly understood, and a reference to the principle of field diversion is desirable. If the locomotive is considered to be standing at rest, and the controller is given sufficient opening to ensure movement, a high initial current flows through the traction motors to produce the necessary torque for starting purposes. When under way with fixed controller setting, the current decreases as the locomotive accelerates, due to a steady rise in the back electromotive force of the traction motors corresponding to the increased speed of rotation of the armatures. This is accompanied by progressive increase in the excitation and voltage of the main generator, which reach maximum values when the torque regulator has reached the limit of its travel. Beyond this point the decrease in current corresponding to any further increase in speed will take place at a virtually constant voltage due to the natural characteristics of the generator, and this is insufficient to give constant horsepower. Further acceleration in fixed traction motor field conditions becomes impossible, therefore, without unloading the diesel engine. In the circumstances, field weakening is employed to reduce the back electromotive force of the traction motors, and thus extend the speed range, by raising the current to such a value as will permit further acceleration without loss in power. The increase in armature current is made possible by diverting a percentage of the current which would normally pass through the field coils through a divert resistance, which is automatically connected in parallel at the appropriate speed. On the present locomotive there are three such stages of field diversion which permit road speed to be increased up to 75 m.p.h. without unloading the diesel engine when working at full controller.

## Test Results

In Fig. 3 are shown the designed rail tractive effort characteristics of the locomotive, and it will be seen that with the maximum engine speed of 850 r.p.m. the net brake horsepower of 920 is equivalent to a rail tractive effort of 5000 lb at 60 m.p.h. The diagram indicates on the five curves relating to varying engine speed the points at which weakening of the field takes place. The actual rail tractive effort characteristics determined in the tests corresponded very closely indeed with the curves worked out by the manufacturers in the design stage. Fig. 2 shows the designed motor efficiency. One of the first items of performance to which a prospective user would naturally




G.C.V. of fuel—19,710 B.Th.U. per pound.

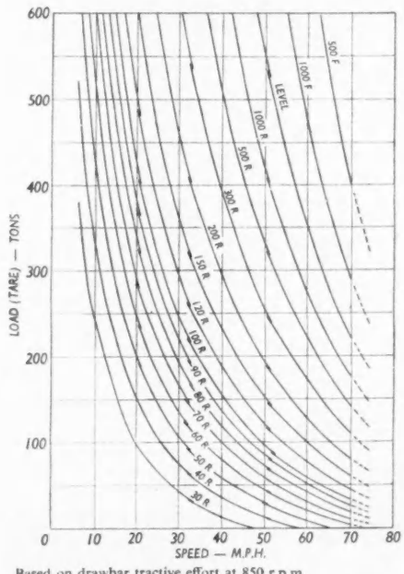
**Fig. 9—Variation in traction efficiency with speed and load (coaching stock—850 r.p.m.)**

turn is that of the drawbar horsepower characteristics, and these are shown in Fig. 4. Curves are included for five different engine speeds, and it will be seen that against the nominal 1000 b.h.p. of the locomotive the maximum drawbar brake horsepower is 700 at 40 m.p.h. and 600 at 60 m.p.h. The steps in these curves indicated the points at which field weakening takes place. Closely associated with the drawbar horsepower characteristics are the related basic fuel

consumption, and these are shown in Fig. 5. The efficiency is at its greatest at low speeds, thus providing for maximum economy with intermediate and transfer goods workings, rather than with passenger trains at higher speeds.

### Power Distribution

In view of the foregoing it is interesting to study an analysis of the various losses in the locomotive at varying speeds, and in Fig. 6 is shown the power distribution at maximum engine speed. From this it will be seen that it is the locomotive resistance that accounts almost entirely for the decrease




Based on drawbar tractive effort at 850 r.p.m.
Tare weight of coach assumed to be 30 tons and gross weight 33 tons to allow for passengers.

**Fig. 10—Relationship of trailing load, speed and gradient (coaching stock)**

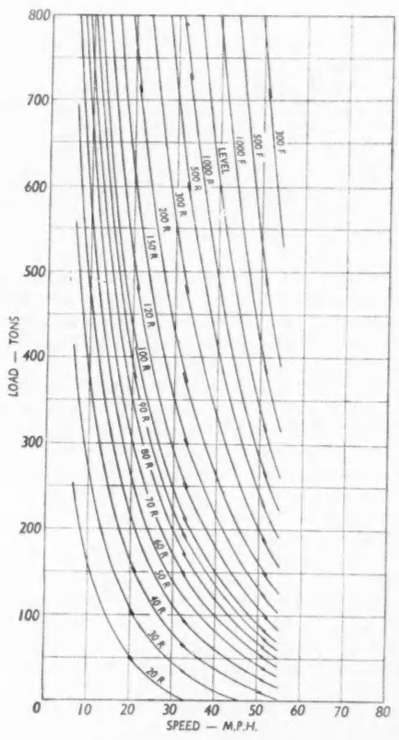
in available drawbar horsepower as speed increases. The motor and generator losses remain virtually constant. In the bulletin corresponding curves are given for engine speeds of 750, 650 and 450 r.p.m.; details from these graphs have been extracted to show comparable results from road speeds at or near the maximum for each engine speed.

| Engine speed, r.p.m. | 850 | 750 | 650 | 550 | 450 |
|---|---|---|---|---|---|
| Road speed, m.p.h. ... | 70 | 60 | 55 | 50 | 45 |
| Engine output, h.p. ... | 1000 | 863 | 695 | 514 | 335 |
| Drawbar horsepower .. | 540 | 485 | 370 | 245 | 120 |
| Locomotive resistance loss, h.p. | 200 | 139 | 125 | 95 | 81 |
| Locomotive resistance as percentage of engine output, h.p. | 20 | 16·2 | 17·9 | 18·4 | 24·0 |

### Variable Speed Road Test

The actual performance of the locomotive on the road, in maximum conditions of power output, is naturally of great interest, and in Fig. 7 is reproduced part of a dynamometer car record, with a trailing load of 452 tons, worked, as far as possible, with full controller. While Fig. 7 gives some of the running data, the table on this page gives an analysis of the results.

So far as power output was concerned the results are shown in the diagram Fig. 8, and an analysis of this shows a very close correspondence to a theoretical curve derived in constant speed tests. This correspondence enables train schedules to be calculated with confidence, not merely from the test results




Based on drawbar tractive effort at 850 r.p.m.
Mixed vans and wagons with class 3 load.

**Fig. 11—Relationship of trailing load, speed and gradient, express freight stock (merchandise)**

but from the designed characteristics of the locomotive.

From the data available some interesting graphs are included in the bulletin relating to the tractive efficiency in various conditions

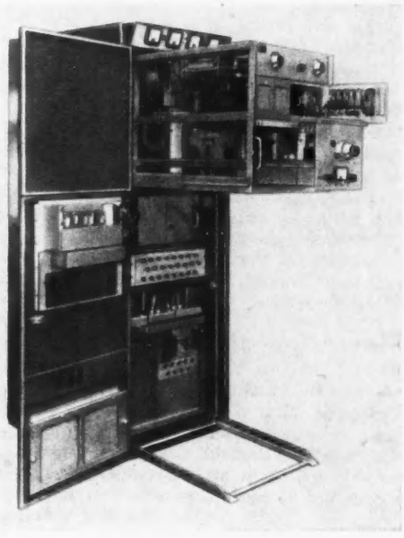
*Results of Test with 452 Tons Train Load. Derby (Nottingham Road) Chapel-en-le-Frith*

| | |
|---|---|
| Load and number of vehicles, tons tare ... ... ... | 452 (15) |
| Distance : | |
| Actual miles ... ... ... ... ... ... ... ... | 51·5 |
| Under power, miles ... ... ... ... ... ... ... | 44·7 |
| Ton-miles (tare weight of trailing load) ... ... ... | 23,278 |
| Time : | |
| Actual running, min. ... ... ... ... ... ... | 99 |
| Under power, min. ... ... ... ... ... ... | 83 |
| Drifting and braking, min. ... ... ... ... ... | 16 |
| Average speed : | |
| On running time, m.p.h. ... ... ... ... ... | 31·2 |
| Under power, m.p.h. ... ... ... ... ... ... | 32·4 |
| Work done : available d.b.h.p. hours (excluding braking) ... ... ... ... ... ... ... ... | 809·23 |
| Average available d.b.h.p. under power ... ... ... | 585 |
| Average available d.b.t.e. under power, lb ... ... | 6,800 |
| Fuel oil : | |
| Gross calorific value, B.Th.U. per lb ... ... ... | 19,750 |
| Total used, lb ... ... ... ... ... ... ... ... | 531 |
| Used under power, lb ... ... ... ... ... ... | 520 |
| Average rate under power, lb per hour ... ... | 376 |
| Used while drifting and braking, lb ... ... ... | 11 |
| Average rate while drifting and braking, lb per hour ... ... ... ... ... ... ... | 41·3 |
| lb/available d.b.h.p. hour under power ... ... | 0·643 |
| lb/mile on total fuel used ... ... ... ... ... | 10·32 |
| lb/mile under power ... ... ... ... ... ... | 11·63 |
| lb/ton-mile on total fuel used ... ... ... ... ... | 0·0228 |
| Energy transmitted to trailing load by 100, energy in total fuel, percentage ... ... ... ... ... | 19·68 |
| Energy transmitted to trailing load by 100, energy in fuel used under power (traction efficiency), percentage ... ... ... ... ... ... ... ... | 20·07 |

of service. The diagram reproduced in Fig. 9 shows the variation in tractive efficiency with speed and load while working passenger stock, and it can be said that this variation is commendably small. In the planning of train schedules two concluding graphs, Figs. 10 and 11, will be of much interest, as they show the relationship of trailing load, speed and gradient for passenger and express freight stock.

## Adaptable Radio Transmitter Range

With the object of enabling operators to build up a communications service which will keep pace with expanding requirements, Redifon, Ltd., Broomhill Road, London, S.W.18, has developed a range of medium-power h.f. transmitters and drive units capable of use in a variety of combinations. Basically this new G.420 series consists of nine 1·5kW p.e.p. high-frequency transmitters for the 1·5 Mc/s to 30 Mc/s range. Up to eight crystal-controlled channels are available in this band and some versions also include a variable-frequency oscillator drive. Transmitters supplied for manual frequency-changing by an attendant may be converted on site for motor-tuning by remote control, or for remote frequency-selection of separate r.f. units for each channel (when the transmitters are of multi-bay construction). Frequency-changing times are stated to be approximately thirty seconds with local manual control, from five to twenty seconds with remote-controlled motor tuning, and less than two seconds with remote selection of drive units. All transmitters are supplied for c.w. and m.c.w. telegraphy and for telephony, using amplitude-modulated emission, and are adaptable to various forms of frequency-modulated waves by the addition of external units. Certain transmitters are supplied with single-sideband and independent sideband telephony facilities, but any one in the range can be adapted for these



**Transmitter with r.f. assembly rolled forward and individual r.f. units opened for inspection**

services subsequent to installation if desired, the necessary generator units being accommodated inside the cabinets. Transmitters from this range with single-sideband and independent-sideband facilities are being supplied to G.P.O. coastal radio stations in order to increase the range of public radio telephony service to ships at sea.

The accompanying illustration shows the "glide-out" unit construction adopted in transmitters of the G.420 series for ease of servicing. All stages have metering, indicator lamps and coaxial outlets for waveform inspection. All transmitters except multi-bay versions with individual r.f. units for each frequency are housed in a single cabinet measuring 6ft high by 2ft 3½in wide by 2ft 10in deep.

---

Precision Tool Factory.—A new factory for the manufacture of precision tools has been opened by Moore and Wright (Sheffield), Ltd., at Handsworth Road on the outskirts of Sheffield to take over the production of the firm's three previous establishments at Trafalgar Street, Meadowhead and Dronfield. For this factory a site of some 12 acres has been acquired and the main works building comprises nine 525ft long 31ft wide bays, with a separate 44,000 square feet office block incorporating a large canteen.

# Oil and the Tractor

*A meeting of the Institution of British Agricultural Engineers was held at Earls Court, on Wednesday afternoon, to discuss a paper on "Developments in Tractor Transmission Systems and their Lubrication," by Mr. E. S. Bates.* The paper, some extracts from which are printed here, outlines the principles involved in the lubrication of the various kinds of gearing employed in agricultural tractors.*

BRITISH tractor manufacturers differ from nearly all others by incorporating the hydraulic circuit in the transmission lubrication system. The requirements of a fluid for a hydraulic lift system are :

(*a*) Flow freely at low temperature.
(*b*) Be viscous enough at high temperature not to leak too easily.
(*c*) Not to attack rubber seals.
(*d*) Not to attack copper.
(*e*) Not to foam.
(*f*) Not to rust nor emulsify with water.

A high quality straight mineral transmission oil can meet part of all these requirements, of course, but there is a great deal of room for improvement left. In this context viscosity alone is much more important to the tractor user than has previously been recognised. The tractor with thicker oil not only takes longer to do certain jobs but even may not be capable of doing them at all until the ambient temperature increases. This is because the transmission oil is too thick to flow at an adequate rate through the valves and porting of the hydraulic lift system. Now one of the most important advantages of mechanisation is the freedom that it gives the farmer to plan work ahead and keep to a reasonable time-table. As the cost of labour goes up it is increasingly necessary for farmers to give thought to reducing working time by working at the highest practical working speed : in this matter hydraulic lift systems play a very important part. The important thing is that the oil be not thin enough to leak past valve seats, sealing rings, &c., and so the hydraulic lift will not let-down under load. This is a very important safety feature.

In cold weather the time for an operation with the hydraulic lift is dependent on engine speed, but if engine speed is too great the hydraulic circuit relief valve will lift thus slowing down the time for the operation to be completed. This also introduces the variable of oil viscosity which is dictated by (*a*) oil quality and (*b*) temperature.

Due to high temperatures transmission oils are apt to deteriorate in quality more readily in the Sahara than they do in Sweden. Eighteen tractors of six different makes have been on test for more than twelve months in Algeria using multi-purpose oil throughout the tractor. To quote a few examples only, in one tractor, the V.I. of the multi-purpose oil in the transmission was reduced from 115 to 107 in 764 hours' use. In another make of tractor the same multi-purpose oil in the transmission was reduced from 115 to 109 in 1358 hours of use. In neither case is the let-down rate of the hydraulic lift increased nor leakage from casings increased : a very important safety feature. With transmission bulk oil temperatures exceeding 100 deg. Cent. (over 212 deg. Fah.) the oxidation inhibitor has been so effective that a gain in performance of the hydraulic system can be noted in winter time.

Multi-purpose oils are now used in transmission and hydraulic systems as well as engines. Thus they must meet the requirements of the transmission and hydraulics already outlined and in addition the summer and winter requirements of the spark ignition and diesel engine. The diesel engine requires a heavy duty oil.

Since a multi-purpose oil is required also to stand up to borderline lubrication conditions in the gearing, the load carrying capacity of the oil must be improved. The additive selected must not damage rubber seals nor copper piping in the hydraulic system nor must it have any undesirable effects when used in the engine. In this respect the additive must also be "water-resistant" because some additives which might appear inert in fact break down in the presence of water and then attack on copper, &c., begins. At the same time thought must be given to choice of an anti-foam additive. Whilst the straight transmission oil does not require it, it is more than likely that the multi-purpose oil which also contains detergent, anti-oxidant and V.I. improver additives for the engine will foam at the entry to the gear pump of the hydraulic system if without anti-foam additive. For obvious reasons this is undesirable.

The foaming test as conducted on the finished oil in the laboratory is a guide only and field tests in a variety of tractor makes should be conducted to verify that foaming at the hydraulic circuit gear supply pump is not detracting from performance.

The rubber test is also conducted in the laboratory on the finished oil in accordance with a prescribed test method. Cross-sections of typical seals used by tractor manufacturers are immersed in the finished oil for thirty-eight days at 180 deg. Fah. The samples are measured for swelling, shrinking, hardening or softening. Lubricating oil from Middle East crude is particularly good in producing only slight hardening and neither swelling nor shrinking. Generally, naphthenic stocks cause swelling and paraffinic stocks shrink seals to an undesirable extent, i.e. more than 6 per cent volume.

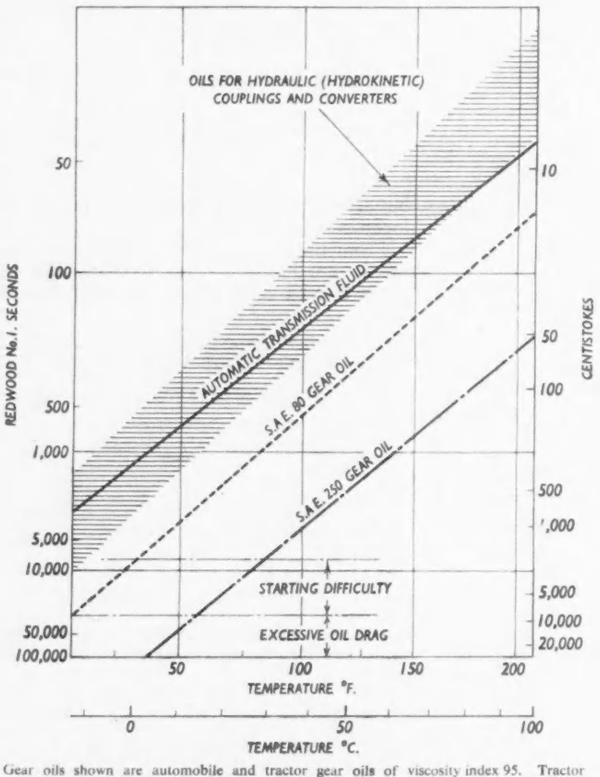
The viscosity index will hardly alter in use in the engine thanks to improved additives available to-day, but the high rates of shear experienced in the sliding of gear teeth (up to 6000ft per minute) will cause loss of V.I. effect in the transmission. Although this does not matter to the gears it is desirable to have a stable V.I. improver additive. A shear test rig in which the additive is circulated through an injection system imposing a high rate of shear is employed for this selection.

The finished oil will also be engine and gear rig tested in the laboratory before going to a field trial period of from twelve to twenty-four months' duration without transmission oil change. A satisfactory multi-purpose oil gives an I.A.E. gear test result of 105 lb, which places it higher in rig test value on average than the heaviest grade straight oil currently recommended.

The field trials by extending engine oil change periods will determine the efficacy of detergent, anti-oxidant, V.I. improver, load improver, and anti-foam additives in combination with selected base oil blends in the engine.

Now that automatic transmissions are becoming standard fitments to motor-cars standardised test procedures for oils are being evolved by manufacturers and in course of time will surely be accepted by oil suppliers. The specification requirements of Automatic Transmission Fluid, Type A, Suffix A of Armour Research Foundation has wide acceptance in English-speaking countries.

This specification is designed to obtain a highly refined mineral oil containing detergent, anti-oxidant, V.I. improver, and anti-foam additives with oiliness agent and pour point depressant if needed. The high temperature in the presence of air in the torque convertor coupled with the small capacity of oil in circulation produces the need for detergent and anti-oxidant combinations. The V.I. improver is needed to cover the temperature range —30 deg. to 300 deg. Fah., as there are bearings to be lubricated also. The fact that these additives are present will also promote foaming and as foaming produces loss of transmission efficiency an anti-foam additive is imperative.




Gear oils shown are automobile and tractor gear oils of viscosity index 95. Tractor gear oils can also be 80 V.I. in which case the viscosities correspond at 100 deg. Fah. with the band width below, but the slope is steeper.

* Technical Services Branch, British Petroleum Company, Ltd.

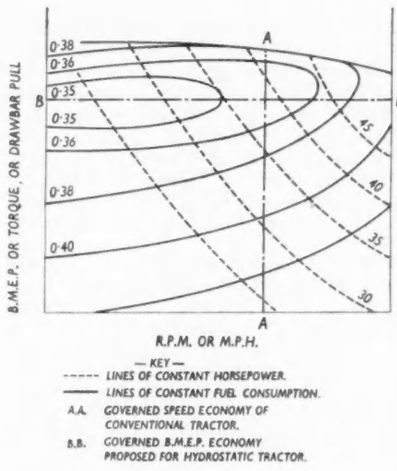
Finally, of course, the finished oil must be non-corrosive, non-rusting, and not attack rubber. Fig. 1 shows the typical viscosity characteristic.

By submitting the fluid to a heating test not only the efficacy of the additives in preventing precipitation and sludge are noted, but also evaporation of the fluid due to its volatility.

In addition to the laboratory tests the transmission fluid is tested on the road for 2000 miles and also in a car installed in a cold chamber.

### Hydrostatic Drive

In the longer term the incremental effect of a depleted agricultural labour force will mean even more complex machinery being utilised to take the place of human skills. Higher wages will be demanded thus increasing the incentive of the farmer to expedite the work of the farm with the least loss of time and in the most efficient manner. These factors in themselves will focus the attention of engineers on to hydraulics so that the more hydraulically-operated equipment is brought into use the greater the proportion of installed horsepower that will be expended through the hydraulic




medium. Ultimately it becomes logical that all the power needed, including tractor propulsion, be provided hydraulically.

The efficiency of a mechanically geared tractor transmission operating always in the intermediate ratios can be taken as 92 per cent from no load to full load, after the oil has warmed up. The efficiency of hydrostatic drive varies however from 70 per cent at quarter load to 85 per cent at full load, whilst that of the torque convertor will lie between 85 per cent and 92 per cent depending on the design of the convertor and the number of mechanical gears added to it.

Despite this it is possible that the hydrostatic drive tractor will produce a lower annual fuel bill than its competitors so long as the output of the diesel engine can be so regulated in relation to the output of the pump that it always runs at its optimum fuel consumption. It may be argued that as a tractor is not always fully loaded[1] a difference such as 70 per cent and 92 per cent in transmission efficiency will wipe out the gain in engine fuel economy settings, but this can be checked in farm practice. A survey was conducted on a 360-acre farm, using a conventional diesel tractor weighing 4755 lb and engine developing 38 b.h.p. On the belt the engine delivered 35·7 belt horsepower and the maximum fuel consumption recorded was 2·5 gallons per hour and the minimum 0·5 gallon per hour.[2] The sixteen farm jobs recorded (by Bryan) can be conveniently placed in groups to which has been added haulage (based on the author's own field experiments) in order to round out the normal farming year.

Group A : Field work, ploughing, heavy cultivation, harvesting standing crops.

Group B : Field work, light cultivation and root crops.

Group C : Field work, haymaking and grass cultivation.

Group D : Haulage.

Group E : Barn work, heavy.

Group $E_2$ : Barn work, light.

Out of a total annual consumption of 1740 gallons of diesel fuel, category A and $E_1$ work, which demand from 80 to 70 per cent installed brake horsepower account for 57 per cent of the total fuel consumption, although the time spent is only 42 per cent of the annual hours. On this particular farm a hydrostatic drive tractor would therefore be operating for the greater part of the time where its transmission efficiency is highest. Unfortunately we do not know the fuel economy characteristics of this engine quoted in the paper other than that at full power rated speed its fuel consumption is 0·485 lb per brake horsepower per hour. If we accept it as the optimum and presume that this optimum figure is maintained with falling engine speed increasing brake mean effective pressure down to one-third of installed brake horsepower then so long as the required variable output from the hydrostatic transmission can be obtained by reducing the speed of the engine and maintaining brake mean effective pressure fairly constant it should be possible to keep the engine at its optimum fuel setting for a wide variety of farm jobs requiring from 30 per cent installed horsepower upwards. If we make another assumption, i.e. fuel sp.gv.= 0·840 we can calculate what the fuel consumption for the hydrostatic drive tractor on this particular farm would be, assuming various transmission efficiencies relative to the power output :

| Work category | Fuel used by normal tractor | Fuel used by hydrostatic tractor | At percentage efficiency |
|---|---|---|---|
| | Gallons | Gallons | |
| A ... ... | 886 recorded | 870 estimated | 82 |
| B ... ... | 393 recorded | 320 estimated | 75 |
| C ... ... | 71 recorded | (65)* estimated | 70 |
| D ... ... | 198 author's estimate | (166)* estimated | 67 |
| $E_1$ and $E_2$ ... | 192 recorded | 192 recorded | Belt work |
| Total ... | 1740 per annum | 1613 per annum | |

* Assumed optimum consumption at low engine speed is 0·600 lb per brake horsepower per hour.

If these assumptions are considered reasonable this case shows that the hydrostatic tractor can return the same consumption as a conventional tractor. In fact, if the engine and transmission are correctly matched the hydrostatic tractor may even have a lower fuel consumption. Obviously engines should be selected for this application which have a very good fuel economy envelope with minimum fuel consumption over a wide speed range and the hydraulic pump output control design such that it can take full advantage. This is a bigger factor than the transmission efficiency (Fig. 2). Finally, there is the sobering thought that the stepless drive itself may produce added economies in working cost per acre and that the overall transmission efficiencies quoted here are extremely conservative.

Not only fuel economy may be beneficially affected but first cost and replacements by doing away with mechanical gearing altogether in favour of hydrostatic drive. If the pump, controls, and motor can be installed cheaper than gears then replacement life can be the same as ground components and engine. Only the "T" structure need carry the full life of the tractor. This should help the development of hydrostatic drive.

An automatic transmission fluid may prove desirable, because of its suitability for a wide range of temperatures. Much of the future oil quality requirement, however, lies at the mercy of the machinery designer. By attention to port, orifice, and valve design foaming can be minimised. The size of reservoir plays an important role in releasing foam and in resisting oxidation. The largest possible reservoir the tractor can accommodate is needed to provide a large surface area, longer time for circulation per unit quantity, and also place for a submerged pump thus obviating the need for a booster pump. In addition, improved cooling of the oil will result so that longer life can be expected.


### References

[1] E. S. Bates, I.B.A.E., 1949, "Tractor Engines and their Fuels."

[2] Bryan, S.A.E. National Tractor Meeting, Milwaukee, September 12, 1946.


## Stoving Enamel

A one-coat stoving enamel known as "Bergercron," now being made by Lewis Berger (Great Britain), Ltd., is based upon acrylic resins with special modifying ingredients and it gives, on baking, a hard, insoluble, infusible coating when applied to practically all metals. This enamel can be applied by all conventional methods—spraying, dipping, roller or flow coating, &c.—and its physical properties can be varied to provide degrees of high corrosion resistance, durability or flexibility to suit particular requirements.

No primer is applied on the metal when using this new enamel, which is usually applied to a thickness of about 0·0016in, or the equivalent of a conventional primer and enamel. It is normally stoved at 350 deg. Fah. for thirty minutes, although the essential properties are not lost if a temperature of 300 deg. Fah. is used. By stoving at 375/380 deg. Fah., the processing time can be halved, but in the event of the stoving time being inadvertently increased up to double the rated period there is no discoloration or damage to the finish. In a special application described by the maker, flame curing at a temperature of 1000/1200 deg. Fah. is effected in four to five seconds on steel razor blades. A blade so treated can be immersed in boiling water for two minutes without damage to the coating.

Tests carried out by the maker have shown that an extremely hard surface finish is coupled with effective adhesion to a metal, whilst it offers excellent resistance to detergents and humidity. In these tests stove enamelled parts have been exposed for 1000 hours at 95–100 deg. Fah. and 100 per cent relative humidity, and completely immersed in water at 100 deg. Fah. for 4000 hours. Coatings have also successfully withstood a standard detergent solution of 2½ per cent concentration for forty-eight hours at a temperature of 160 deg. Fah.

A point of particular interest in connection with metal stove enamelled with "Bergercron" is the flexibility of the coating which enables subsequent firming and machining operations. It is stated that holes can be punched or drilled in finished sheets without the enamel flaking or cracking back round a hole. This flexibility is advantageous in preventing damage to a stove-finished component as a result of accident or mishandling during assembly or other processes of manufacture.

# Failure of Malpasset Dam

The UPPER VIEW shows Malpasset dam at the time of its completion, and the two LOWER VIEWS show the dam site and the valley of the Reyran after the catastrophic failure of the dam last week. The dam was the key structure in the water supply of a large area in the eastern part of the Var department, and it formed a reservoir close to the French Mediterranean coast with a useful storage of 25,000,000 cubic metres. It was a thin arch structure with a maximum height above the stream bed of 60m (plus a further 6·5m of foundations below the stream bed level) and a maximum thickness, near its base, of 6·91m ; the crest thickness was 1·5m, the upstream radius of the arch 105m at the crest, and the subtended angle 135 deg. The valley profile at the site is trapezoidal, 30m across at the bottom, and 180m across at the crest level.

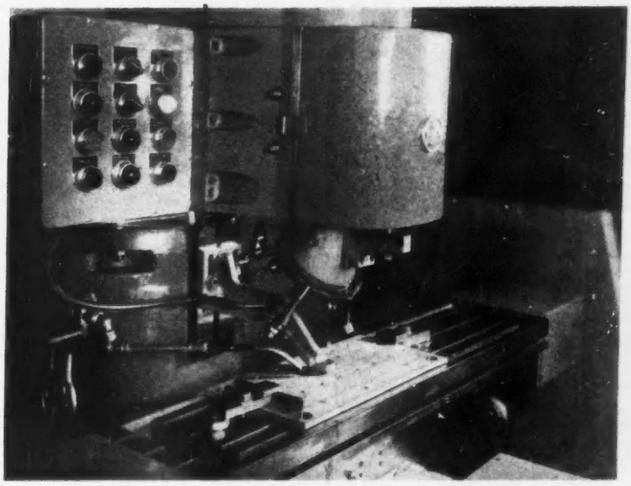
These details were given in a description of the dam by M. J. Dargeau, chief engineer of the Rural Services Department, published by the French journal *Travaux* at the time of the Fifth Congress on Large Dams. Malpasset dam, M. Dargeau stated, was built " under the direction and control of the Rural Services Department with the technical assistance of the consulting engineer's office of Messrs. Coyne and Bellier "; the main contractors were Entreprises Leon Ballot and Gianotti Freres, drilling and grouting was done by S.I.F.P., Bachy, Etablissements Neyrpic was responsible for the sluice valves, and the Société Coloniale at L'Estaque-Marseille supplied the cement.

Construction of the dam started in April, 1952, and was completed in thirty months. The constructional methods generally appear, from M. Dargeau's description, to have followed the lines which would normally be expected in a structure of this kind. For instance, the dam was built in seventeen blocks, each 13·5m in length with contraction joints between them ; the concrete had 300 kg, or in some cases, 250 kg, of cement per cubic metre, with customary stipulations for aggregate grading and water-cement ratio. A scour culvert passed through the dam near its base, and a steel intake pipe 0·9m in diameter passed through it at the 79·5m level. There was a spillweir at the crest, at level 100·4m. The geology of the Reyran basin was described by M. Dargeau as " a synclinal carboniferous zone enclosed by the metamorphic horizons of the base Massif of the Esterel."

The LOWER ILLUSTRATION shows the dam after failure, from upstream. The great majority of the main bulk of the dam has completely disappeared ; however, the lowest parts of the dam in the stream bed appear to be intact, and the scour culvert is evidently functioning. The right abutment is also intact, and the concrete has broken away close to it at the construction joints, giving a stepped appearance. At the left abutment, it is difficult to trace the line of the dam, and it appears from the illustration that there is an inclined plane of rock exposed. Any attempt at explanation of the failure must necessarily be conjectural until the findings of the committee appointed by the French Ministry of the Interior to investigate the failure are known. But inferring from the illustration alone, it would appear that the failure may have originated at the left abutment. There is a large block of concrete lying close behind this abutment, which may have been part of the intake (which included a chamber for energy-dissipation). Otherwise, little of the concrete of the dam is visible, though some of it appears to be just beneath the aircraft wing. The illustration on the LEFT of the page shows the devastation in the valley immediately below the dam, the distance downstream where some of the shattered concrete lies, and the height of the flood marks conveying an idea of the violence of the failure and the consequent flood. According to the correspondent in *The Times*, the right bank abutment is in gneiss, but at the left abutment " for most of the way down the side there is no trace of even the foundations of the dam ; only a smooth shale-like surface so friable that it crumbles underfoot."

# Programme Controlled Turret-Head Drilling Machine

*The prototype of a new design of turret-head drilling machine with programme control was recently demonstrated by Vero Precision Engineering, Ltd. On this machine up to 600 holes of six different diameters can be drilled in an automatic cycle. On the right the machine can be seen in operation fitted with a steady bush and bracket attachment, and drilling a plate component.*



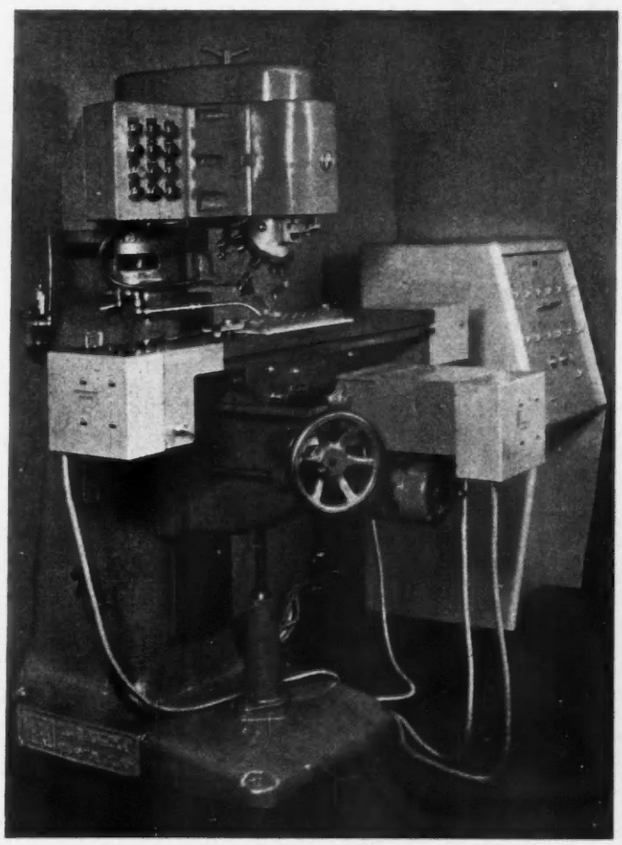
A TURRET-HEAD drilling machine developed by Vero Precision Engineering Ltd., of Southampton, is provided with a tape controlled programming equipment by which the settings of the table and the indexing of a six-spindle turret are effected automatically throughout a drilling sequence. Up to 600 holes in six sizes can be drilled in a component in a preset pattern and guaranteed tolerances of ±0·003in on this machine. Its turret-head chucks take drills up to $\frac{5}{16}$in and the 32in by 9in table has a longitudinal traverse of 24in and a cross traverse of 12in. The 16in vertical travel of the knee gives a maximum setting distance of 20in between the spindle and table.

The electro-mechanical co-ordinate setting equipment of Airmec, Ltd., High Wycombe, which is supplied with the machine, is so arranged that during the table positioning movement the turret is simultaneously indexed to present the appropriate drill, tap or reamer in its operative position. The Airmec "Autoset" co-ordinate setting system operates by accurately measuring the total angular rotation of the lead screw by a servicing head known as a "positioner," one of which is fitted on each of the table lead screws. Each lead screw is driven by a reversible motor through a gearbox and clutch. In the table setting operation, when a lead screw has nearly reached its required position a signal is passed to a control unit, causing the electric motor to change to half speed. At another point much nearer to the final position a second signal is passed by the positioner to a magnetic clutch which disengages direct drive and brings in a 25 : 1 reduction gear. The run-in to the final position then takes place at slow speed and as soon as the lead screw reaches its position the magnetic clutch is disengaged and the table stopped simultaneously.

With this arrangement initial table movements are effected at the top speed of 1in per second, reducing to a secondary approach speed of $\frac{1}{2}$in per second and a final positioning speed of 0·02in per second. To minimise the effects of backlash error in the lead screw the drive is so arranged that the approach to final position always takes place in the same direction.

The makers point out that lead screw inaccuracies can be restricted to less than 0·0005in per foot, but if a closer degree of precision is required on a machine a correcting cam can be incorporated in the drive to compensate for cumulative lead screw errors. By the use of special jigging the guaranteed drilling accuracy of the machine can be reduced from ±0·003in to ±0·001in.

The control equipment for the machine is mounted in a separate cabinet, and the programme is punched in a 4in wide plastic tape some 70ft long—which is sufficient for a programme of 600 complete operations. The programmer is situated in an easily accessible recess in the rear of the control cabinet and on it the tape is fed from one roller to another. At each setting position the tape roller drive is stopped by a light shining through a locating hole on to a photo-transistor. The table co-ordinate settings and other information relating to each drilling cycle are read off the tape by spring-loaded pins which only bear on the tape when it is stationary.



**Programme controlled turret-head drilling machine with control cabinet**

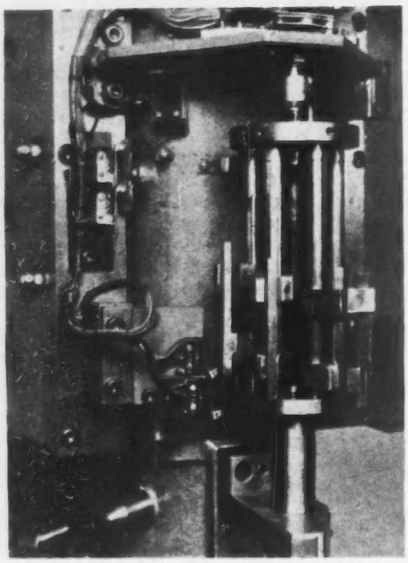
The drill head is driven by a $\frac{1}{2}$ h.p. a.c. motor giving six electrical speed changes, any of which can be selected from the tape. Drive is transmitted through a three-cone pulley by which the most suitable range of spindle speeds can be selected for the material being drilled, the overall range available covering 300 to 6000 r.p.m. The drill head with its front cover removed can be seen in our last illustration. In this head each of the spindles has in the indexing turret an associated slide carrying adjustable dogs which operate the micro-switches of fine feed and depth stop controls. Other microswitches are used to signal to the control unit when a drilling cycle starts and is completed. A standard three-wafer, six-position rotary switch at the top of the turret controls its indexing movements and selection of individual spindle speeds.

An air/hydraulic system is used for effecting the spindle feed motions. In the sequence of operation under automatic control, once the table has been correctly positioned and the right spindle as indicated on the tape has been selected, a "start" signal is sent to the main air control valve for the spindle feed. Air then admitted into the air/hydraulic system moves the spindle downwards until the fine feed micro-switch is operated. This switch controls a solenoid pilot-operated valve which causes the hydraulic oil to be diverted through an adjustable restrictor valve, when the spindle can move downwards at the selected feed speed. This feed continues until the depth stop micro-switch is operated to reverse the main air control, returning the spindle to its top

position, de-restriction of the passage of the hydraulic oil giving a fast return movement. If on certain operations, such as tapping, it is necessary for part of the upward movement to be at fine feed rate, this can be achieved by punching the appropriate signal on the tape.

Spindle selection is initiated by an appropriate signal from the control and should the turret not be located on the spindle indicated it indexes until the rotary switch coincides with the required spindle. The indexing relay then closes to stop further turret rotation and a start signal is sent to the control to begin the machining operation.

For certain classes of work the drill heads can be fitted at each spindle with a guide bush of the appropriate drill size as shown in the illustrations. At each drill a lever, spring



**Indexing turret control unit. The feed control microswitches on the lower left-hand part of the head are operated by adjustable dogs on the bars**

loaded in the downwards direction, carries a bush. A rigid bush steady bracket is fixed to the stationary column of the machine and its bore is located in line with the spindle axis. In the drilling operation initial downwards movement of the spindle inserts the bush into the steady bracket bore until its head arrests further movement. The drill passes on through the bush to carry out the drilling operation whilst guided in the same way as with a slip bush in a conventional drill jig. It is stated this equipment enables tolerances within $\pm 0{\cdot}002$in to be easily achieved.

The makers of the machine claim that the wide range of drill sizes and spindle speeds provided with the automatic control system allows the economic drilling of components, plates, printed circuits, &c., in any quantities from twelve upwards, without need for costly templates or drill jigs. Means of manual setting and control incorporated in the equipment facilitate and speed the production of components in small numbers and the drilling of templates.

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HEAVY FUEL OIL FIRING UNIT.—Urquhart's (1926), Ltd., has extended its range of packaged oil firing units with the MacFlame series designed to burn residual fuel oil with a viscosity of 960 seconds Redwood. There are five models which cover the range of 1,450,000 to 5,500,000 B.Th.U. per hour and have a maximum fuel rate from 115 lb to 450 lb per hour.

# Agricultural Machinery at Earls Court

*The Smithfield Show and Agricultural Machinery Exhibition began at Earls Court, London, on Monday morning and will end this (Friday) evening. Traditionally, the title of the show emphasises the exhibits of prime cattle which are again up to the customary high standard. But the livestock occupies only a fraction of the exhibition space. By far the greater part of it is taken up by a machinery display which demonstrates the continuing progress of agricultural engineering.*

ALTHOUGH it has not been staged at Smithfield for well over a hundred years, the exhibition of cattle and other livestock which is held in London in the first week of December is traditionally known as the Smithfield Show. Since the war, the words " and Agricultural Machinery Exhibition " have been appropriately added to the title, for the exhibition—the only one of its kind held annually in London—regularly presents a vast quantity of machinery and components. The organisation of the exhibition is undertaken by a committee representative of the Smithfield Club, the Agricultural Engineers Association and the Society of Motor Manufacturers and Traders.

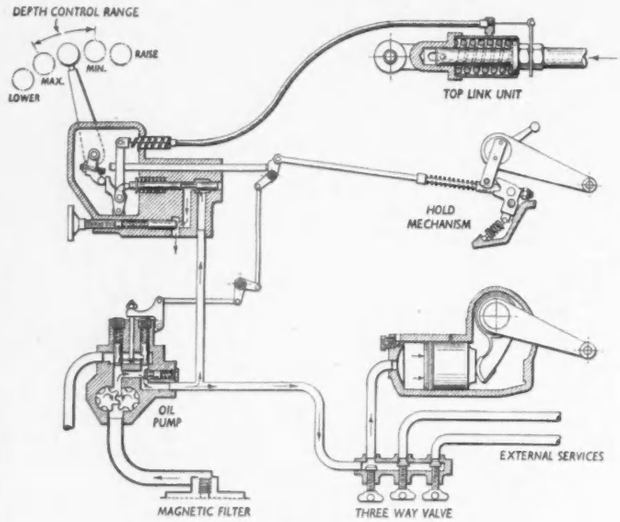
This country's agricultural machinery industry makes a valuable contribution to engineering production. It has recently been described by a farmer-economist* as a " brand-new colossus," the turnover of which has gone up from £3,000,000 in 1935 to £142,500,000 in 1958. It is estimated by the Association of Agriculture that in the United Kingdom there are now 1000 firms producing agricultural machinery and spares, employing between them 39,500 full-time operatives. But half these firms each employ fewer than ten men and 900 employ fewer than 100. Only about 130 firms have an annual output worth more than £25,000. There are seven firms, all tractor manufacturers, which are responsible for approximately 85 per cent of the agricultural machinery industry's total output. Another interesting statistic is that, for each worker employed, the industry exports annually about £2300 worth of its products. Last year, for example, exports of British tractors and other farm machinery reached a value of approximately £100 million. One-third of these machinery exports went to Commonwealth countries. But a somewhat surprising trend in recent years has been for countries which are already industrialised to purchase an increasing quantity of farm machinery from other countries. As a result of this trend, the U.S.A. now buys a considerable amount of British agricultural machinery. It is claimed, in fact, that one out of every twenty-five wheeled tractors sold in the U.S.A. is entirely British made.

* J. T. Beresford, *National Provincial Bank Review*, November, 1959.

## TRACTORS AND ENGINES

For a general survey of the machinery exhibited at this year's Smithfield Show it is appropriate to begin with the tractors. Among the wheeled tractors, there are some developments designed to increase efficiency for agricultural use and for work outside the farm.

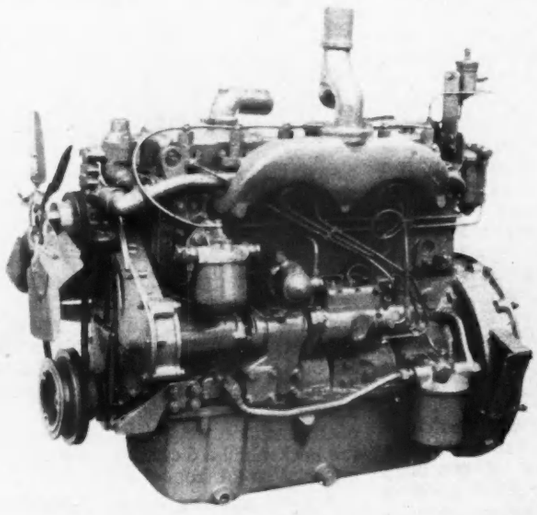
One such development has just been announced by The David Brown Corporation (Sales), Ltd., Meltham, Huddersfield. This company is showing a tractor equipped with what is designated the " Implematic " all-purpose hydraulic system. It is claimed




**" Implematic " tractor hydraulic system**

that this development resolves a problem which has beset farmers ever since linkage-mounted implements were introduced over twenty years ago, namely, the incompatibility between automatic draught control and depth wheel control. The " Implematic " tractor is capable of operating either of these two main classes of mounted implement. A single control lever is used to operate either kind of implement, the same lever being used for the application of the traction control unit which, it may be recalled, is the firm's anti-wheel slip device enabling the transfer to the tractor's rear wheels of a controlled proportion of surplus implement weight. To provide for implements without depth wheel, the " Implematic " system, illustrated diagrammatically herewith, incorporates an arrangement known as " traction and depth control " (T.D.C.). The top link is spring-loaded and is under compression from the draught forces acting on the implement. Compression of this top link actuates, through a Bowden cable, the movement of a hydraulic valve. For any given control lever setting, the implement goes into work until the set draught is

achieved. As the ground conditions vary, the draught automatically increases or decreases as does pressure in the top link ; this in turn causes the hydraulic valve to move. When the draught increases, the valve allows more oil to be pumped into the lift cylinder so that the implement is raised and the draught restored to the preset figure ; when the draught decreases, oil is allowed out of the lift cylinder, permitting the implement to go deeper into work. When the tractor is working implements fitted with depth wheels, the hydraulic system operates in exactly the same manner and, similarly, traction control is applied by movement of the lever.



Perkins six-cylinder, 76 b.h.p. agricultural diesel engine

The " Implematic " system is to be the standard equipment of the David Brown 950 tractor, production of which started earlier this year (THE ENGINEER, January 30, 1959). Another addition to the standard specification of this tractor is the provision of a differential lock to give additional protection against wheelspin especially when using trailed equipment.

The tractors shown by Massey-Ferguson, Ltd., Coventry, include the various models of the M-F. 65 and M-F. 35. The M-F 35 was introduced three years ago, the diesel version having a four-cylinder engine rated at about 37 b.h.p. A new engine has now been produced for this tractor. Its designation is M-F. 3-A-152 and it is a three-cylinder diesel developing a maximum torque of 110 lb ft at 1250 r.p.m. The engine, which is fitted with chromium plated liners, is designed to give 37 b.h.p. at a maximum speed of 2000 r.p.m. Furthermore, the design incorporates many parts identical with the 50 b.h.p. diesel engine of the M-F 65 tractor. Coincident with the introduction of the new engine, the " 35 " is to have a new clutch and its fuel tank capacity is being increased to 8½ gallons. One of the " 35 " tractors exhibited is a high-clearance version. The 702 industrial tractor, described in our issue of October 2, is also exhibited with its digger and loading shovel attached.

The tractors exhibited by International Harvester Company of Great Britain, Ltd., 259, City Road, London, E.C.1, include the the B275, a 35 b.h.p. machine, to which there is now fitted a two-speed power take-off. The standard p.t.o. speed on British tractors is 540 r.p.m. and for some time there has been debate as to the desirability of following the lead given last year by the American Society of Automotive Engineers in the establishment of a second p.t.o. speed of 1000 r.p.m. With this two-speed arrangement, International Harvester claims that non-standard machines operating at about 700 r.p.m. can be satisfactorily driven by reducing the tractor engine speed yet retaining good engine torque characteristics.

Hydrostatic transmissions for tractors are demonstrated on two stands. Reference to the system evolved by the Dowty Group, Ltd., Cheltenham, has already been made in these columns (THE ENGINEER, August 21, 1959). Originally the name " Transmatic " was applied to this transmission, but in future it is to be known as "Dowmatic." The hydrostatic transmission system devised by Joseph Lucas, Ltd., Birmingham, working models of which are exhibited, was described in detail in our issue of October 23.

Manufacturers of oil engines with particular application to agriculture are well represented at the show. Perkins Engines, Ltd., Peterborough, is exhibiting an agricultural engine, the " Six 288 (TA)," which is offered for large self-propelled combine harvesters and is suitable for medium or heavy wheeled and crawler tractors. The engine, illustrated herewith, is a six-cylinder, vertical, in-line unit, 3·5in bore and 5in stroke, capable of developing 76 b.h.p. at 2000 r.p.m. ; the maximum torque is 207 lb ft at 1400 r.p.m. The engine is fitted with a C.A.V. distributor fuel pump and has " built-in " calibration. Dry, pressed-in cylinder liners are incorporated and there is a 12V " Thermostart " heater in the induction manifold to assist starting in cold weather ; a water manifold is fitted along the combustion face of the cylinder head to ensure uniform cooling. An auxiliary drive shaft is provided on the nearside of the engine to drive the lubricating oil pump, fuel lift pump and fuel injection pump, the exhauster and fuel injection pump being driven in line.

Another new engine which has been designed for farm use is the " AC1 " single-cylinder air-cooled diesel manufactured by Bamfords, Ltd., Uttoxeter, Staffs. It is capable of developing up to 6½ b.h.p. at 1800 r.p.m. The drive can be taken from the flywheel end of the crankshaft with an extension shaft or, alternatively, from the half-speed shaft, a further variation being a pulley bolted direct to the flywheel.

Several makers of engine accessories are also exhibiting. On the stand of Simms Motor Units, Ltd., East Finchley, London, N.2, there is displayed a large 3-D photograph of the " Minipump," a new fuel injection pump for diesel engines having a capacity of up to 1½ litres per cylinder. Three, four and six-cylinder models are available. The body which contains the pump elements and fuel passages is machined from solid steel, instead of aluminium alloy as in the firm's larger fuel pumps. The method of fuel control, it is stated, is similar to that on the Simms " A " pump in which the partial rotation of the pump plungers opens spillports sooner or later in the stroke as desired. An arm at the lower end of each plunger engages with a fork on the control rod, the latter moving under the influence of the governor and the accelerator pedal. The excess fuel device and the maximum fuel stop are built into the governor casing.

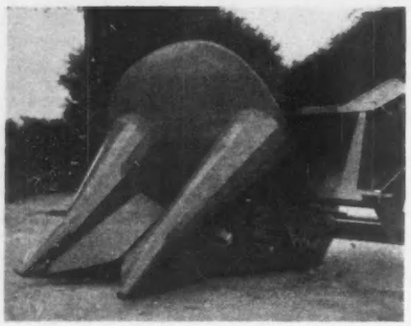
### HARVESTING MACHINES

It is doubtful if in any part of the farming cycle mechanisation has progressed as rapidly as in the harvesting of all kinds of corn and grass crops. As usual, there are many harvester-threshers, or " combine-harvesters," as they are familiarly called, exhibited at Earls Court. As these are machines which must perform several operations—cutting a standing crop, conveying it to the threshing drum, separating the grain from the chaff, and disposing of chaff, straw and any trash—they, of necessity, have more moving parts than most other agricultural machinery. Free running, under the most difficult conditions, is an essential !

The harvesting of grass and forage crops is a matter which continues to receive the close attention of agricultural engineers. The exhibits of machinery in this category are numerous, many of them demonstrating considerable versatility. There are many machines available for the cutting of grass and other green crops for silage making, and the results of research into this

David Brown " Super-Hurricane " silage and green-feeding machine

operation become increasingly apparent. The David Brown Albion Division, Huddersfield, is showing a combined silage cutting and green-feeding machine which, provisionally, is called the "Super-Hurricane." It comprises a moving-floor trailer with a rear-mounted flail forage harvester. The complete machine, which is power take-off driven, is hitched directly to a tractor, and operates as an in-line outfit. The flail cutter unit is fitted with castor wheels and can be raised and lowered hydraulically. With this unit in the lowered position, cutting and loading are carried out simultaneously, the cut crop being fed forward into the trailer through the harvester chute. When the trailer is full the flail cutter unit is raised clear of the ground hydraulically, as shown by our illustration, and the entire outfit is



**Maize attachment for Lundell forage harvester**

driven to the silage pit, where it is reversed into position for off-loading, and the flail unit lowered to the ground. A baffle plate in the rotor housing of the flail unit is rotated to blank off the chute and provide a rearward exit for the crop. The moving-floor mechanism in the trailer is then put into motion and the crop is fed by means of three sets of shredders to the rotating flails, which blow it through the rearward opening directly into the silo. The direction of discharge can be varied by movement of an adjustable deflector plate, enabling the cut crop to be distributed evenly to all parts of the silo without need for any spreading by hand. In designing this outfit, special attention has been paid to the requirements of "zero grazing." A cross-conveyor attachment has been designed for fitting to the unit to give direct discharge of the cut crop to the ground or into feeding troughs.

The flail forage harvesters exhibited by Lundell (Great Britain), Ltd., Lingfield, Surrey (now associated with Allied Ironfounders, Ltd.) include the "Super 60" which is offset to the tractor and which has a cutting width of 4ft 10in. In recent months, tests have been made with this machine on tall—and rather tough—crops such as maize and sorghum. The maize attachment, which we illustrate, is fitted to the front of the harvester, its function being to guide the maize stalks into the cutting cylinder. This attachment carries its own rotor which is equipped with six heavy duty knives, each 18in long, forming a cylinder 22in in diameter. An adjustable shear bar enables the chopping and laceration of the crop to be controlled.

A German machine designed to expedite the task of conventional haymaking is the Colman-Fella tedder exhibited by Colman and Co. (Agricultural), Ltd., 20–21, Tooks Court, London, E.C.4. It is power take-off driven and is hitched to the back of a tractor operating a side-mounted grass mower; two operations are thus performed simultaneously. The central shaft of the tedding cylinder is divided into two parts by a flexible coupling and there are two sets of six rods on which tines are arranged. The flexible coupling is so placed that, when in operation, an angle is formed between the two shaft members; this gives the thicker part of the swath built up by the mower's mouldboard rougher treatment than the rest. The grass is tossed against a large hood which partially encloses the tedding cylinder and is then carried from 4ft to 5ft through the air and lands lightly in a wide swath on the stubble. This enables air to circulate freely thus assisting rapid drying.

A new baler, introduced recently by International Harvester Company of Great Britain, Ltd., 259, City Road, London, E.C.1, is illustrated herewith. This power take-off driven machine is designed to produce bales from 18in to 42in in length and up to 70 lb in weight. The crop is picked up by five rows of tines and a fully floating short auger acts as a cross-feed, discharging into a large storage area which is cleared every four-fifths second by triple packer fingers. These pass the material into a 14in by 18in bale chamber. The knife plunger, which rides on spring steel runners, has a speed of seventy-five strokes a minute. The baler is fitted with a weatherproof four-ball twine compartment and has a long, adjustable drawbar to ensure maximum manœuvrability.

The handling and stacking of hay or straw bales is one of those laborious tasks on a farm that now show signs of becoming fully mechanised. A number of bale elevators and tractor-operated bale loaders are exhibited. One of the latter, which we illustrate, has been designed by a farmer and is being made by Barford (Agricultural), Ltd., Grantham. It is a simple attachment which can be fitted to most standard hydraulically-operated front-end loaders. It operates on a mechanical claw principle and, actuated by the weight of the load, a stack of eight bales is grabbed by the sides, lifted, carried and deposited on a trailer. On release of the weight, the claws open sideways and permit the loader to be withdrawn without disturbing the load on the trailer.

### Other Equipment

The show naturally includes a great variety of tillage implements for large acreages and for market gardening, sprayers, root crop harvesting machines, grain drying and storage equipment and dairy machinery. Then, too, there are machines and implements which do not fit directly into any of these classes but which are important to mechanised farming and good husbandry at home and overseas.

Land drainage, for example, is a matter which calls for unremitting attention. A number of trenching and ditch cleaning machines are on view. That which we illustrate is the Leeford tractor-mounted ditch cleaner and digger, the concessionaire for which is F. A. Hughes and Co., Ltd., 4, Stanhope Gate, London, W.1. The machine incorporates a telescopic boom system and can be operated by most tractors equipped with hydraulic lift. It will deal with ditches up to 6ft wide and 6ft deep, the spoil being ejected to be spread on the land or, if desired, emptied into a trailer towed behind the machine. The bucket assembly travels on a heavy tubular section from the ditch to the discharge point and back again to the ditch, the cross traverse of the bucket being controlled by a hydraulic ram. The lifting and lowering of the bucket are controlled by a second hydraulic ram and a third ram operates the digging, scooping and discharge motions. When discharging, the bucket is moved through nearly 270 deg. round a static paddle which pushes the earth out. Counterweights are fitted on the side of the ditcher to counteract the weight of the full bucket and a 6 cwt counterweight is also mounted on the front of the tractor.

A new implement shown by Bomford and Evershed, Ltd., Salford Priors, Evesham, is the "Sapper" reardozer. The maker claims that it represents an entirely new approach to the problems of control and wheel adhesion encountered when wheel tractors are used for earth-moving. This implement is designed for use with Massey-Ferguson tractors and is shown fitted to a Massey-Ferguson 65. The reardozer is carried by the normal three-point linkage and takes full advantage of the tractor's draught control system. A reversing mechanism enables it to respond to thrust, the weight of the implement being automatically transferred between the cutting edge and the rear axle, giving maximum wheel adhesion and penetration under all conditions. The operating linkage has been designed to give a closely controlled floating

**International Harvester pick-up baler**

Barford bale loader

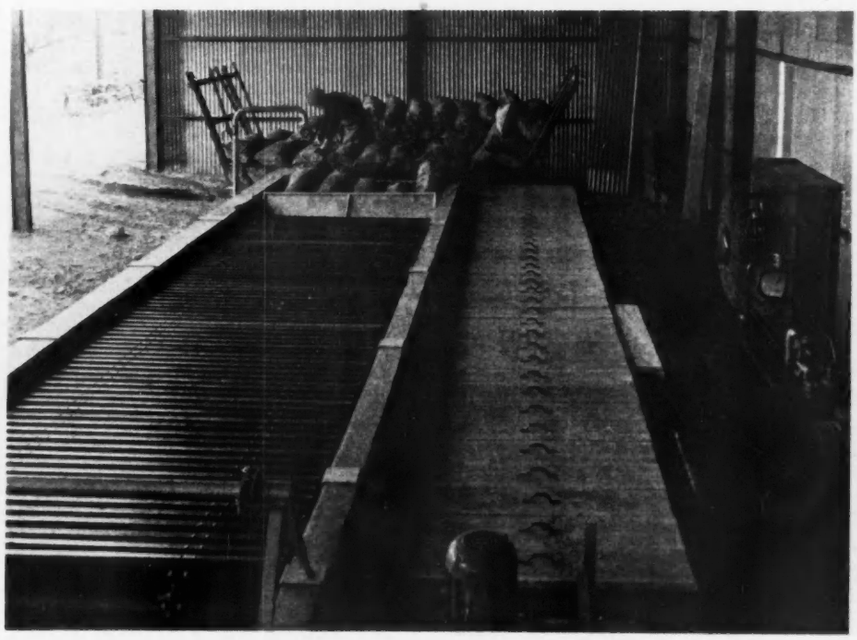
Leeford ditch cleaner and digger

action. An additional feature is that the blade can be turned round to become a heavy duty rear grader, automatic draught control being retained. A reversed control outfit to solve the problem of driver comfort when operating for long periods, and a detachable scarifier for the breaking up of hard ground are available as extras.

Our final illustration shows an immersion hydro-cooling plant for vegetables, which is exhibited by J. and E. Hall, Ltd., Dartford, Kent. The process consists basically of the immersion of freshly-cut vegetables in water at a temperature just above freezing, the aim being to assure a " field fresh " appearance.

The conveyor hydro-cooler consists essentially of a tank approximately 3ft 6in to 7ft wide and 40ft long, with a chute at one end and a sloping mechanical lifting conveyor at the other. The depth of water in the tank is 16in to 20in. A horizontal electrically-driven slatted conveyor is fitted above the tank and is so placed that the lower run of the conveyor is just below water level. Crates are passed in lanes down the chute into the water, and, due to their natural buoyancy, float up and press against the underside of the horizontal conveyor, which propels them gently to the far end of the tank. The sloping conveyor then elevates the crates to a convenient height of approximately 3ft 6in, whence they are removed by an operator.

In conclusion, we mention some magnetic plates for farm grain or meal conveyors which are exhibited by Wolseley Engineering, Ltd., Witton, Birmingham. They can be installed quickly and easily into existing grain or feed chutes and, once fitted, will draw out any iron and steel which may have become accidentally mixed with the grain or meal, thus protecting both animals and machines. The magnets are permanent and require no wiring or electrical fitting of any kind. The only maintenance necessary is to clean any pieces of steel off the plates at regular intervals. The magnets used are of a well-proved industrial design and are available in a range of sizes and strengths. Those shown are suitable for a 6in chute, where the depth of material does not exceed 2½in and the chute does not slope at more than 45 deg. The plates are usually fitted to the base of the chute and are supplied with a hinged flap at one side which allows them to be opened and cleaned easily. It is stated that normal vibration does not affect the magnetic strength.



Hall hydro-cooling plant for vegetables

## Hunting Probe for Indicating Liquid Levels

THE United Kingdom Atomic Energy Authority has devised an instrument called a " hunting probe liquid level indicator " which can be used to measure changes in the levels of various liquids with very high accuracy—amounting in one particular application to under one-tenth of a millimetre over a range of 10m, or better than one part in one hundred thousand. It could be used to provide very fine control in water-moderated reactors where the height of the water in the core is the factor determining the power level.

Major components in one application are a datum which is a spring-loaded contact plate ; an electrical probe with a platinum point contact suspended from a stainless steel wire wound on a stainless steel drum ; a split field d.c. motor, a thyratron and a level indicator.

Initially, with the probe out of the liquid, a change-over switch is actuated, which energises the first field of the motor and turns the drum, allowing the probe to descend. As soon as the point of the probe touches the surface of the liquid, a circuit is completed which fires a thyratron. This energises the second field of the motor with twice the current in the first field, over-riding it and turning the motor in the opposite direction. The probe is thus raised until contact is broken with the liquid surface, when the cycle is repeated. Accordingly the probe will " hunt " above and below the surface of the liquid, but such is the speed of response of the circuit that the amplitude of motion of the probe is only a few thousandths of an inch. The mean position of the probe is the true level. The hunting motion can be taken up so as not to be repeated by the pointer, the latter always indicating the mean position. The pointer on the level indicator is arranged to rotate only once for a very small change of level and the number of turns is given on a second dial.

The gauge described here is virtually independent of the nature of most liquids. It is so sensitive that it can be used with demineralised water, and will operate with a resistance of up to 20 megohms between contact and earth.

[Reply Card No. E7791]

# LETTERS AND LITERATURE

## Letters to the Editor

*(We do not hold ourselves responsible for the opinions of our correspondents)*

### LIGHTWEIGHT DIESEL TRAINS

SIR,—I have just read your report of Mr. R. A. Smeddle's paper on diesel trains in THE ENGINEER dated September 25, 1959, pages 309–310, and am rather astonished about the great emphasis placed on light weight.

I have made extensive use of the diesel trains around Birmingham and as long as the maximum speed is less than 40 m.p.h. they are extremely comfortable, but in 1958 my family travelled by diesel express to Malvern in the leading coach and the lateral oscillations at high speed could only be compared with some of the grimmer tortures in the fairground at Blackpool. Fortunately, the journey only lasted an hour, but the shock to the nervous system was so severe that when later in the year we contemplated travelling to Swansea, my wife ordered me to find a steam train at all costs. We have actually travelled to Swansea since by diesel, making sure of our seats in the centre of the train, and it was certainly more comfortable, but nowhere near as smooth-running as the main line steam corridor stock.

In my opinion, the L.M.S. main line corridor stock is the most comfortable coach I have ever ridden in, and those of your readers who travelled on the "Coronation Scot" before the war will confirm the excellent riding at high speed. Surely the weight and stiffness of the train as a whole is responsible for this.

If railway passengers of the future are to be persuaded to sit in trains for periods varying between two to eight hours at high speed, whether diesel or electric, they must be guaranteed a degree of comfort equal to the present main line steam trains. None of the diesel services at present operating from Birmingham are designed to give it because they are all too light.

E. L. M. SHIPWAY

Birmingham, 27,
December 7, 1959.

### MORAL DIGNITY OF PLEASURE

SIR,—Many of your readers, I feel sure, will find pleasure from your comment, in to-day's issue, on pleasure! The world in general is continually being reminded that the pace of technological and social change is now more rapid than ever it was, but I wonder sometimes if those reminders are taken very seriously. Undoubtedly, it is an out-of-date idea that "we ought to feel a twinge of conscience whenever we indulge in any pleasurable activity" but an important corollary to that surely is that work, whether extending over many hours or few, must be *conscientiously* performed if leisure is to be fully enjoyed. Providing outlets for people's leisure hours is already an extensive and, in some cases, a lucrative business, the moral value of which is frequently a subject for argument. Perhaps we all need to learn a bit more about the most satisfying use of leisure. Lord Chandos's suggestion that the Government, institutions, firms, and other organisations, should pay more attention to the arts is an excellent one. It is to be hoped, however, that it will not spark off a demand for the setting up of a Ministry to promote leisure and pleasure. It is still a good idea for us all to find ways and means of doing something for ourselves!

W. JAMES

Potters Bar,
Middlesex,
December 4, 1959.

### THE IMPERISHABLE TRAM

SIR,—May I add one further quotation to the interesting collection in your Editorial of November 13.

The second verse of John Arlott's poem "Southampton" is as follows:

> "Galleon tram-cars gong and rattle
> Round the Bargate to the Quay
> And the unexpected glimpses
> Of a grey, unsea-like sea."

This was published in his volume "Of Period and Place" by Jonathan Cape, 1944.

J. P. M. PANNELL

Engineer to the Board,
Southampton Harbour Board,
Southampton,
December 2, 1959.

## Book Reviews

**Lubrication of Bearings: Theoretical Principles and Design.** By E. J. RADZIMOVSKY, The Ronald Press Company, 15, East 26th Street, New York 10, U.S.A., Price 10 dollars.

JUDGED from the number of books on the subject published recently in the United States of America, the design of bearings is regarded there as a subject of increasing importance. In so far as the general basic principles have been fairly well appreciated for some seventy years, some speculation as to the cause of this interest may be warranted. Reynolds' paper was published in 1886 which, among other things, led to the invention by Michell of the tilting pad bearing. This was the only great inventive step in the development of plain bearing practice and, as it occurred over half a century ago, one wonders why so much attention is now being paid to basic lubrication science.

The reasons for this are twofold: first, the duty demanded of bearings during the major part of the intervening period was such that sufficiently satisfactory designs could be arrived at by trial and error methods so that there was little need for designers to be well acquainted with theory. There was therefore little demand for textbooks in which the theory was expounded. The development of mechanical engineering has led to situations where greater demands are made on bearings, sometimes in unusual environments. The development of the gas turbine and nuclear power are instances of this. Designers in satisfactorily meeting such demands have had to pay closer attention to theory and have revealed inadequacies which have led to a spate of research work. The present work meets the demand for a complete exposition of classical theory but does not begin to remedy the inadequacies of that theory.

The book has been written to provide the basis for a one semester course in lubrication for graduate students and undergraduate students of senior standing. Some five chapters are devoted to exposition of Reynolds' theory and its application to slider bearings. Then about forty pages are taken up with the discussion of the behaviour of an idealised concept without counterpart in mechanical engineering, namely the journal bearing without side leakage. Reality is more nearly approached in the following chapter where Kingsbury's leakage factors are applied to theoretical values obtained on the assumption of infinite length. This brings the reader to the point reached by Swift in 1932. No reference is made to this original treatment nor to the classical advance made by the same author in his exposition in 1937 of the fundamentals of bearing stability. Indeed, this important and difficult topic is dismissed in a page without any attempt at mathematical treatment.

Having indeed devoted the major part of the book to classical theory, the author has space for only perfunctory treatment of such important questions as oil flow, thermal equilibrium and instability. Moreover, there is no serious treatment of experimental evidence nor any attempt to assess the validity or limitations of the theory in the light of such evidence. This, coupled with a neglect of modern theoretical work (e.g. the approximations introduced by Du Bois and Ocvirk or the calculations of Sassenfelt and Walter are not mentioned) must deprive the book of any claim to be a comprehensive treatise.

This is admittedly an educational work in which the more difficult aspects of the subject appear to have been avoided, no doubt out of kindness to the student. We question, however, the value to him of rigorous mathematical treatment on the basis of questionable assumptions, and we are certain that the practising designer will find the emphasis and content of the book at variance with his real needs.

**The Work of the Public Health Engineer.** By L. B. ESCRITT and S. F. RICH. Macdonald and Evans, Ltd., 8, John Street, Bedford Row, London, W.C.1. Price 75s.

THIS well-produced book, which has now gone into a third edition after several reprints, is based on the work of A. J. Martin under the title of *The Work of the Sanitary Engineer*. In the first part there are two introductory chapters on the definition of the public health engineer and an outline of his work including the writing of specifications, although the example of an inaccurate specification of ten lines on page 28 is not "shortened considerably" by replacement with fourteen lines as claimed on page 29! In Part II there are four chapters on law and administration (pages 49 to 90) which are well known to the municipal engineer but not to others, such as the consulting engineer, for whom the book may have its value.

In Part III (pages 111 to 244) the whole subject of water supply is covered as far as it is possible to do so in so few as 100 pages,

and in this varied subject the authors have been wise to enlist the help of E. S. Boniface, F. H. Edmunds and H. R. Lupton, the well-known authorities on certain aspects of water supply, hydrogeology and pumping respectively. Nevertheless, certain parts of this section should be modified and co-ordinated in future editions because, as they stand, they tend to give wrong impressions. Thus on page 118 lakes seem to be particularly subject to contamination. The Bunter series (page 127) is hardly equal to the Chalk formation in importance as a water-bearing formation, although a square mile of outcrop of each may be. The Chalk probably yields four to five times as much as the Bunter in Britain. Again on page 126 the "cone of depression" is mentioned but nothing about the amount of rain percolating into the underground system, nor is there anything very much about underground water contours. Similarly on page 147 the three driest years applied to the cumulative diagram for ascertaining the yield of an impounding reservoir, is, of course, a particular case which dies hard and advantage might have been taken to give some indication of run-off from rainfall for periods other than the three driest consecutive years. The description of the siting of a service reservoir (page 156) might have been usefully expanded, not merely stating that the water should be stored near the town but also that it should be sufficiently high to command the district but not so high as to necessitate pumping the whole of the supply at prohibitive cost. On page 116 the Flood Committee of the Institution of Civil Engineers' report, which is based on a vast amount of authenticated data of run-off, is rather scantily treated, and the word "nevertheless" can be misunderstood. A good deal of the water supply section, therefore, wants carefully re-writing and co-ordinating. Possibly some aspects should be omitted as not being in the province of the public health engineer.

Part IV, the sanitation in houses, cold and hot water systems, fittings, traps, vents, tanks, is a convenient transition from water supply to sewerage and land drainage (Part V) and sewage treatment and disposal (Part VI). These parts are more comprehensive than the rest (pages 335 to 771, over 400 pages) and are well thought out. The last chapter contains a somewhat brief account of public cleansing.

Despite our criticisms the book is still to be recommended as a first rate contribution to the practice of the treatment of sewage, the methods of disposal of sludge, and the law in relation thereto, with subsidiary information on water supply, public cleansing and the work of the public health engineer.

**History of the Gear-Cutting Machine.** By ROBERT S. WOODBURY. The Technology Press, Massachusetts Institute of Technology, Cambridge 39, Massachusetts, U.S.A. Price 3.00 dollars.

To anyone interested in toothed gearing and methods of producing it, this is a fascinating book, albeit rather expensive. A thirty-page section, headed "The Mathematics of Gears," outlines the history of suggestions for the forms of gear teeth and of methods of laying them out. The greatest preoccupation in this field was with attaining minimum tooth friction, this being specially important for clock gears, where, however, departures from exact conjugacy of tooth-form are not seriously detrimental. Not until the Industrial Revolution did primary attention begin to shift from friction to smooth running. Similarly, as hinted in a section on "The Clock and Instrument Makers," it was about then that gear-cutting machines began to change from lightly loaded instruments into special machine tools with good capacity for removing metal quickly.

A fifty-page section records the history of "Production Gear-cutting Machines" from about A.D. 1800 and might perhaps have emphasised that tooth-generating processes soon made most of the mathematics of gears superfluous, although few seem to have appreciated the fact. To anyone who chafes at the persistence of antiquated ideas about gears and the general resistance to any suggestion that their technology becomes greatly simplified when stripped of useless Victoriana, this book offers the wry solace that advances in gearing have always been appallingly slow. We learn that the cycloid tooth-form was studied at least as far back as 1451 and that after 240 years it was shown to be inferior to the involute, but that another 140 years had to elapse before involute teeth were actually used and a further sixty before they started to become common. In 1835 Whitworth built a machine that could produce gears of the involute form recommended in 1694 by the hobbing process that had been known since 1768. This combination, widely used in the last sixty years, rendered the form-cut cycloid gear obsolete for power-transmitting gears but text-book exposition of gearing still employs terminology that obscures the fact. As this history shows, the half-century is the appropriate unit of time for recording progress in ideas on gears.

In reading the section of this book on the mathematics of gears, one gains some idea of the extent of the labour of centuries in discovering, forgetting, rediscovering, advocating, opposing and suppressing pieces of information about the geometry and operation of toothed gears. The process still continues without real gain, the only advances over the last hundred years having been in manufacturing techniques. Traditions never really die and by living may hinder progress. An example mentioned in this book was the reluctance of practical men, with the restrictions of the cycloidal tooth system in mind, to believe that a single involute generating cutter may produce accurate tooth-forms in gears having any number of teeth. The depressing feature here is that the point can be demonstrated quite simply by cutting a few gears with different numbers of teeth and meshing them together. Unfortunately, the scientific method of making a trial instead of merely talking about it does not convince the practical man who has had a few theoretical ideas firmly implanted in him. He may refuse the evidence of his own eyes, if some tenet tells him that it cannot be done. This part of the book is an excellent review of the slow, tortured approach of a few simple ideas to acceptance by a majority of those interested in the subject. In gearing technology, general acceptance of anything less than a hundred years old seems impossible.

Willis showed in 1841 that a worm is simply a helical gear with a small number of teeth and a short lead, and although at least one patent was taken out on this idea many years later, it is sometimes strenuously denied even with the twentieth century more than half-spent.

It appears from this book that there has always existed the regrettable tendency to make gear geometry seem highly mathematical and, in some practical men, the equally regrettable tendency to believe it and to take unction from the doing of superfluous sums. Conversely, the lack of any kinematic need for any precise tooth-form in clock gearing permitted practical men to let imagination run riot in this subject and to use tooth-forms that no mathematician could explain! In referring to some of the difficulties encountered in early applications of the hobbing process, the author mentions the belief that the axis of the hob must be given a precise angular setting relative to that of the work, but does not make it clear whether he also accepts this myth. There is great reluctance to believe that the helical character of a gear tooth is defined by a length (the common lead of the helices that compose it) rather than by any particular angle, even though the mode of setting up a hobbing machine to cut a helical gear should make the matter clear.

The author concludes by saying that the gear-cutting machine "embodies at once fine mathematics, mechanical ingenuity and machine work of the highest order" and might have added that these three attributes are in steeply rising order of importance. A gear-cutting machine may be made without any use of mathematics beyond arithmetic and without any mechanical devices less than a century old, but there is no substitute for precision.

It is quite clear that much library research has gone into the preparation of this book and an extensive bibliography is quoted. There are numerous illustrations of great historical interest and the story ends at about the year 1915.

**Package Design Engineering.** By K. BROWN. Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 68s.

IN the years since the late war, considerable attention has been given to the subject of correct and efficient packing of materials and equipment to ensure full protection in transit and storage. In connection with engineering, scientific and military equipment, packaging has increasingly become a field in which a number of firms have specialised and, as the author of this book says, "the state of the art has progressed rapidly in the engineering approach to package design."

The book is based upon a course in industrial package design prepared for the University of California at Los Angeles. It first deals with the basic fundamentals in static and dynamic mechanics, strength of materials and stress analysis required by an engineer to give a background for solving structural and dynamic packaging problems. Various forms of mountings and suspension systems are given in detail, followed by discussions on the properties of containers in different materials, and notes on dehumidification and pressurisation.

## Books Received

*The Directory of Opportunities for Graduates*, 1960. Cornmarket Press, Ltd., 1, Lower James Street, London, W.1. Price 8s. 6d.

*Machine Design.* Third Edition. By R. C. Patel and A. D. Pandya. Acharya Book Depot, Baroda, State of Bombay, India. Price Rs.12.50.

*Kinetics of High-Temperature Processes.* Edited by W. D. Kingery. Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 108s.

*Property Measurements at High Temperatures.* By W. D. Kingery. Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 132s.

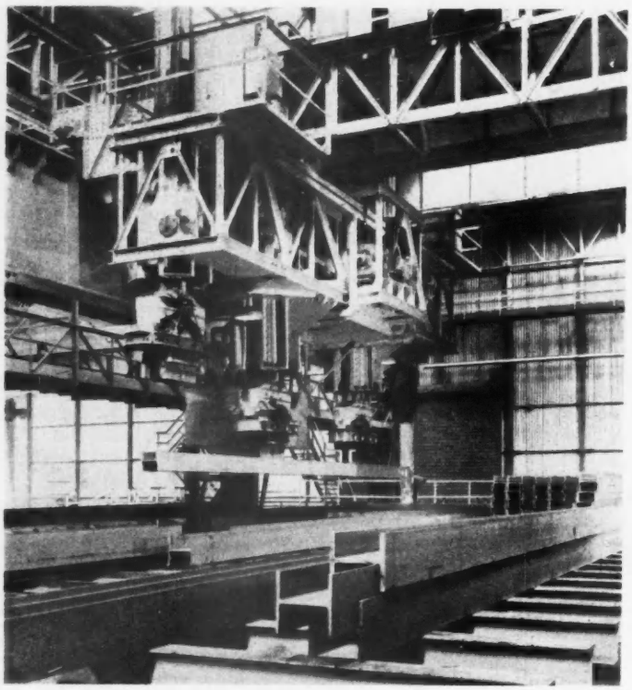
*Principles of Frequency Modulation.* By B. S. Camies. Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 21s.

*Sixth Anglo-American Aeronautical Conference, Folkestone*—1957. The Royal Aeronautical Society, 4, Hamilton Place, London, W.1. Price 126s.

*Problems in Strength of Materials.* By R. S. Paradise and G. A. Church. Blackie and Son, Ltd., 17, Stanhope Street, Glasgow, C.4. Price 25s.

# 10-Ton Magnet Cranes for a Beam Mill

*Two magnet cranes of unusual design have been supplied by the Wellman Smith Owen Engineering Corporation, Ltd., for stacking beams at the Lackenby universal beam mill of Dorman Long (Steel), Ltd. Each of these cranes is designed to handle beams up to 36in by 16½in by 260 lb per foot with lengths from 16ft to 90ft, and stack them into nested piles, as shown in the illustration on the right.*



TWO magnet cranes were specially designed by the Wellman Smith Owen Engineering Corporation, Ltd., of Parnall House, Wilton Road, London, S.W.1, for installation in the universal beam mill which was put into service at Lackenby by Dorman Long (Steel), Ltd., in 1958. The general construction of these cranes can be seen in the illustration and drawing we reproduce.

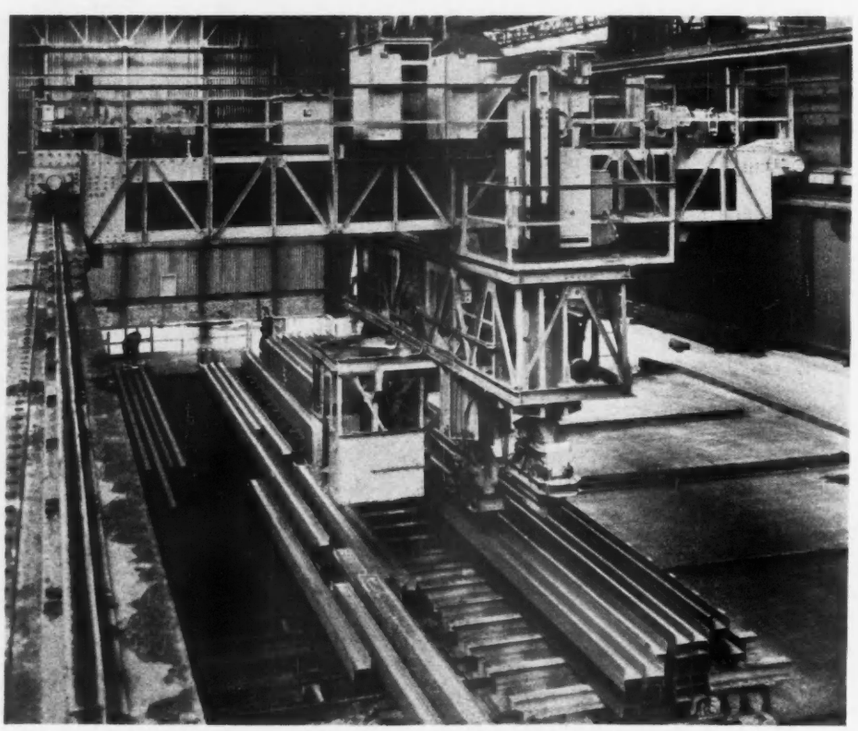
Each crane is capable of lifting a maximum load of 10 tons, and can handle beams ranging in size from the smallest, 8in by 5¼in, weighing 17 lb per foot, to the largest, 36in by 16½in, weighing 260 lb per foot, with lengths varying from 16ft to 90ft and stacking them into nested piles up to 4ft in height. Large beams are lifted singly, by placing the magnet poles in contact with the web, but the smaller sections are lifted in pairs, with the magnets spanning the adjoining flanges of the two beams.

Four specially designed bipolar magnets, developed for beam handling purposes, each have two faces 32in long with a gap of 5in between each face. This 5in gap is necessary not only to allow the magnets to bridge the flanges of two joists when light sections are being lifted, but also to limit the loss of flux across the air gap between the poles. When handling heavy sections, the magnets lift on the centre of the joist web. Each magnet has an outer vertical face 8½in deep to enable the poles to reach the webs of beams having flanges 16½in wide. These deep poles enable contact to be made with the flanges of a joist when it is lying horizontally and enable it to be skidded across the bank by using the trolley cross-traverse drive.

Each magnet is fitted at the lower end of a vertical mast, to which is bolted a rack with machine cut teeth. The four masts operate in pairs—two inner and two outer—and while the long beams are carried on all four magnets to prevent sagging at the ends, only the two inner ones are used for the shorter beams. When handling short beams, the outer magnets are raised clear, as shown on the drawing and photographs.

Suspended from the trolley frame of the crane is a braced hanger structure carrying a horizontal beam of parallel lattice braced construction at right angles to the crane bridge structure. On this hanger structure there are mounted two sets of hoisting gear—one set for hoisting and lowering the inner masts, and the other set for the outer masts. The inner hoisting unit is powered by a 35 h.p. motor driving through two spur gear reductions to a cross shaft, at both ends of which are fitted pinions gearing with the mast racks. The outer hoisting unit is of similar design except that the second reduction gears are fitted on the ends of the main cross shaft and from there drive to the rack pinions. There is no mechanical connection between the two hoisting units, the control equipment being suitable for operating either or both hoist motors as required. These hoisting units have a designed speed of 45ft per minute.

The masts are of plate and channel construction and guided by double sets of rollers throughout their vertical stroke, which is 5ft for the inner masts and 8ft for the outer masts. An interesting means of attachment is used between the magnets and their masts. Each magnet is suspended from its mast by two short slings which run over freely revolving pulleys on the mast in such a way that the magnet can tilt to accommodate itself to a beam which deflects as it is lifted. The form of suspension also allows for some



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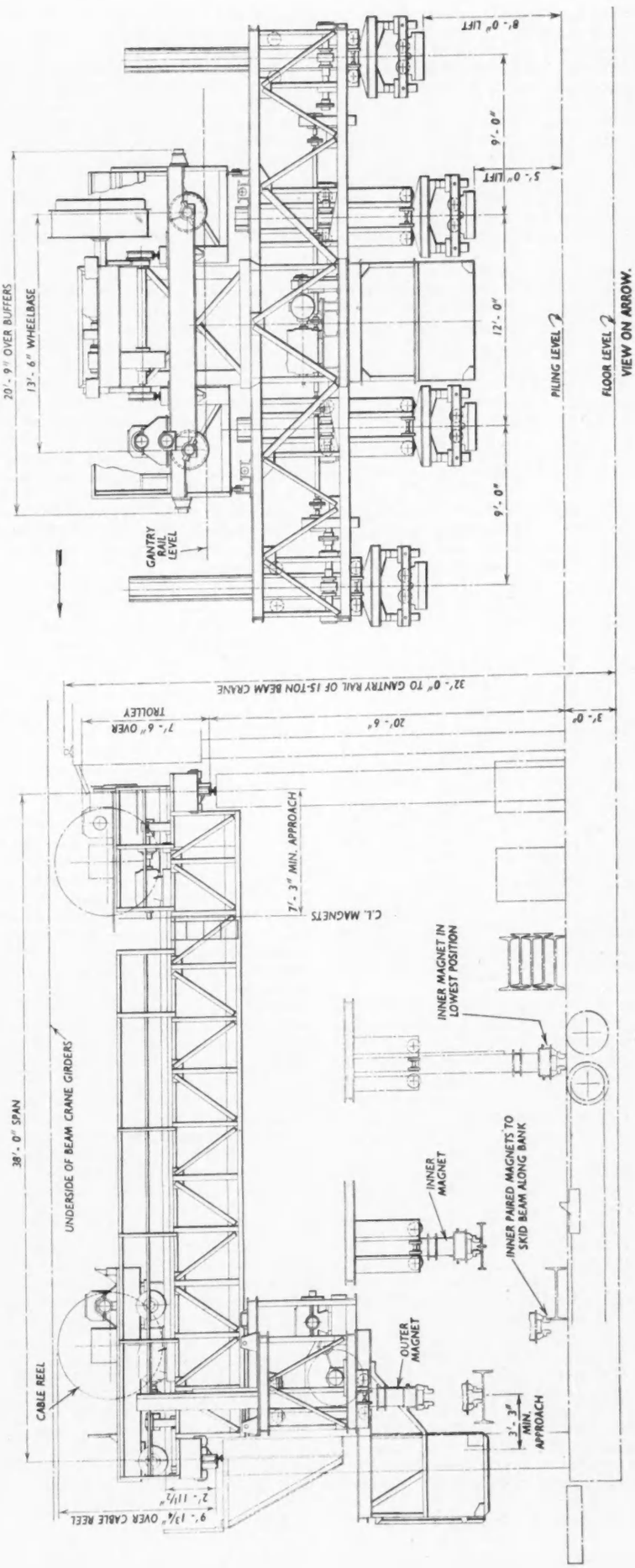


General arrangement of 10-ton magnet crane

lost motion between the settling of a magnet on the beam and the stopping of the downward movement of the mast by the shunt limit switch connected in series to the lowering circuit of the hoist panel. The extent of the tilt of a magnet is limited by guides on the mast to the maximum deflection expected in beams (which has been calculated). The structural frame into which each magnet coils and pole pieces are built has ends of non-magnetic steel, so that the whole of the flux must pass via the pole pieces and the beam being lifted.

The driver's cab housing the operator and control gear travels with the trolley. It is built out centrally from one side of the hanger structure below the main cross beam, to give the operator an uninterrupted view of all magnets through their stroke range.

The trolley travels on four 18in diameter double-flanged cast steel wheels secured to through-running axles. The cross traverse motion, driven by a 35 h.p. motor through double spur gear reductions, has a speed of 200ft per minute. Current supply to the trolley is delivered through two separate flexible cables. One end of each cable is fastened to a terminal box at opposite ends of the span, while the other end coils on to a Wayne Booth contactless reeling drum mounted on the trolley.

Each of the cranes has a span of 38ft and on each of the single web plate main girders there is an auxiliary girder of lattice braced construction carrying the chequer plate platforms, travelling gear and long travel contactor panels and resistances. The end carriages are of channel construction reinforced by diaphragms to form a box section, and they are attached to the girders by bolted connections with large gusset plates. Spring buffers are provided at each end of the carriages and provision is made for the insertion of lifting jacks for maintenance purposes.

A crane travels on four 24in diameter double-flanged tyred runner wheels fitted to short axles, running in phosphor bronze-bushed self-oiling bearings which are of the run-out design to facilitate maintenance. Two of the wheels are driven, one at each end of the crane, by two 25 h.p. motors placed at the ends of the girders and on the opposite side from the trolley cable collecting gear. The long travel speed is 250ft per minute and the control is such that the crane can be squared up on its track to ensure that the magnet beam is always square with the stock it has to handle.

The power supply at 230V d.c. is taken from main collectors of the Dorman Long gravity design, running on rigid conductor bars situated at one side of the shop above the crane gantry girder. All gearing on the crane is of steel with machine-cut teeth and having double helical first reductions. All reduction gearing is enclosed in welded steel oil bath gearboxes with integral bearing housings, except the long travel spur rim end drives and the hoisting racks and pinions. All bearings except those of the long travel axles are of the roller anti-friction type fitted in renewable shells. Hand-operated grease pump lubrication is provided for all bearings except the flange guide rollers and the long travel axle bearings. The motors of the crane are of totally enclosed one-hour-rated series-wound heavy-duty mill design, each motor being connected to its gear drive by a Wellman Bibby all-metal flexible coupling.

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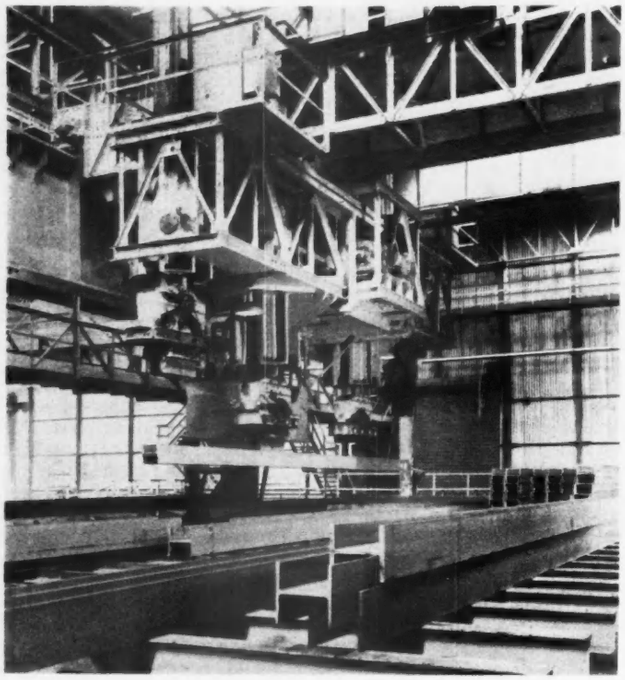

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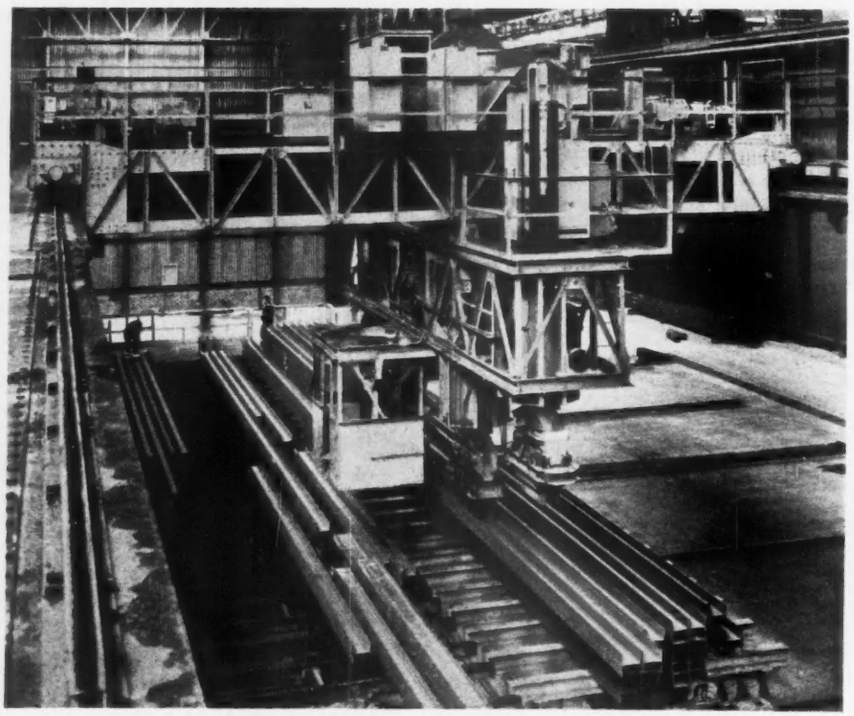

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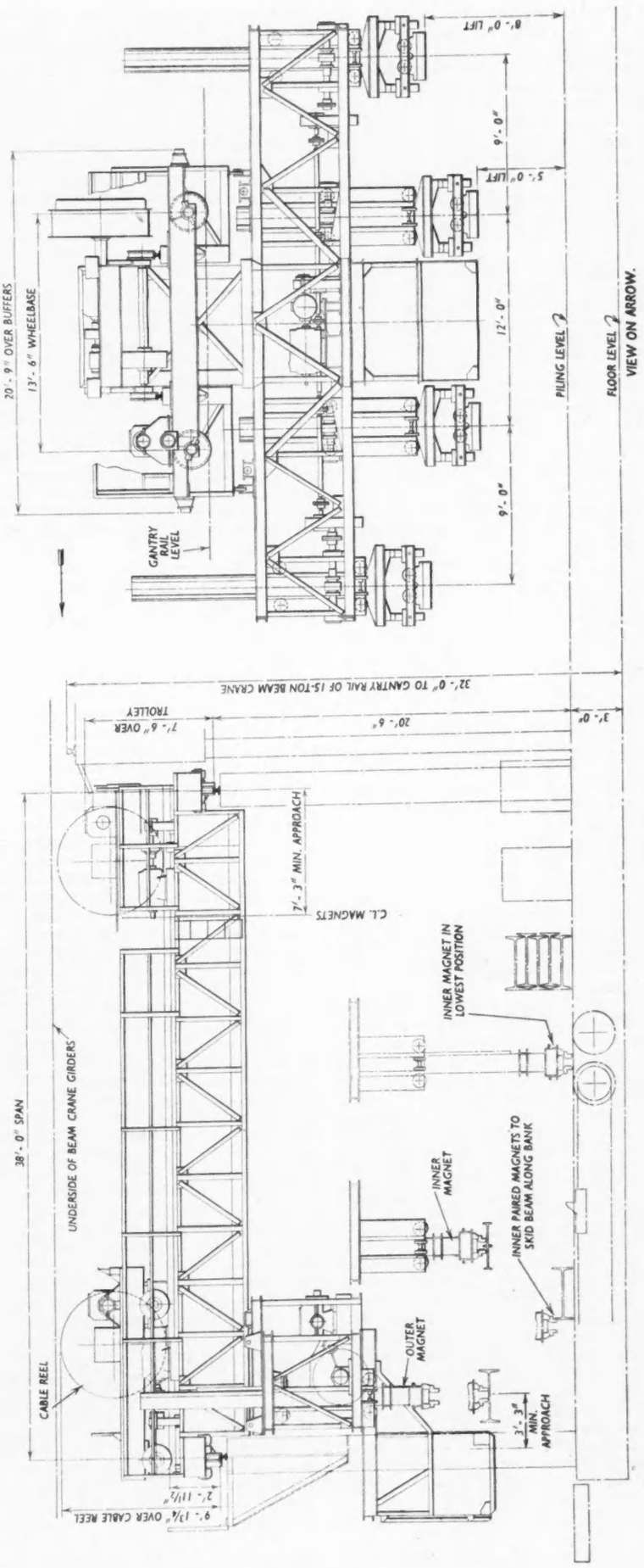


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The control gear comprises enclosed contactor panels for all motions. For the hoisting motions two panels are provided, one for each motor, to give plain series control hoisting with dynamic braking and

potentiometer control lowering. Similarly, for the long travel motion, two panels are provided, one for each motor, to give two-stage plugging control and series resistance acceleration in both directions. The two controllers provided for the two hoist motions are mounted side by side on a common bed-plate with the two handles close enough to allow either or both motors to be operated as desired with one hand. Protection for all five motors is afforded by an enclosed protective panel having mill duty contactors and overload relays for each motor circuit along with one common relay. The four magnets are controlled by enclosed contactor gear, the equipment comprising panel, master controller and resistances. A special selector switch enables two or four magnets to be brought into operation, and the necessary interlocks are provided to ensure correct timing for this to be done. A double-pole circuit breaker is mounted in the driver's cab and a 500A main isolating switch provided adjacent to the main collectors to enable the complete electrical equipment to be isolated when required.

The hoist motors are fitted with series wound magnetic brakes. Shunt brakes on the long travel motion only come into operation on failure of current or when used for parking purposes. The cross traverse motion is fitted with an electro-hydraulic brake.

Over-winding of each hoist motion is prevented by a shunt limit switch with an additional hand resetting switch of the type which comes into operation in the event of failure of the first switch.

# Corrosion Problems of the Petroleum Industry

THE initiative of the Corrosion Group of the Society of Chemical Industry in organising, on November 26 and 27, a joint symposium on " Corrosion Problems in the Petroleum Industry " was widely welcomed. This was the most recent of a notable series of symposia, which the same Group has organised, and engineers may find in the printed records of them a balanced, unbiased, scientific yet very practical attack on many of the more serious corrosion problems. In brief, they have covered : " Buried Metals," 1951 ; " Caustic Cracking," 1952 ; " Inhibitors," 1953 ; " Cathodic Protection," 1953 ; " Structural Steel," 1955 ; " Packaging and Storage," 1956 ; " Metals in Buildings," 1957 ; " Motor Vehicles," 1958 ; " Petroleum Industry," 1959.

Most of these symposia were held in London at the headquarters of the Institutions of Civil, Mechanical or Electrical Engineers ; two of them were held in the provinces at the Universities of Manchester and Birmingham.

This year the symposium was arranged in collaboration with both the Chemical Engineering Group of the same society and with the Institute of Petroleum and the proceedings commenced with a reception at the Washington Hotel, Curzon Street, London, W.1, on the evening of November 25. The following four technical sessions were held in the Hall of the Federation of British Industries, 21, Tothill Street, London, S.W.1, and of the 230 who registered to attend, several belonged to more than one of the sponsoring bodies but no less than forty non-members also registered to attend. The nine papers were important contributions to the subject and, being available in preprint form, they evoked useful and informative discussions.

The chairman for the first session was C. M. Vignoles, C.B.E., the President of the Institute of Petroleum, and the first paper to be presented was that by G. A. Lee and G. A. Haines on " Corrosion of Production Equipment and Gathering Lines and its Prevention," thus starting at the root of all the problems. In their consideration of internal well corrosion they differentiated between sour corrosion, where hydrogen sulphide causes large, deep pits and heavy iron sulphide scale, and sweet corrosion associated with carbon dioxide and organic acids. During the last fifteen years the use of corrosion inhibitors has become common in combating these forms of corrosion in oil wells.

External corrosion of well casings is now recognised as a major problem and encouraging results have been achieved with the experimental use of cathodic protection of well casings at Kuwait. Corrosion of surface installations is less where the well has been given an inhibitor treatment but severe problems of corrosion exist in tankage. During the last fifteen years off-shore operations have become of major importance and corrosion occurs in the submerged zone, the splash zone and also in the atmosphere.

Speaking from the point of view of the Kuwait Oil Company, Ltd., the authors concluded that early production had been from shallow fields and the available methods did not make for high ultimate recoveries. As capital investment and field life were both low, there had been, in the early days, little incentive to investigate corrosion seriously. Now improved production techniques have resulted in longer field life ; it now costs more to find new fields ; with deeper drilling there has been a rapid expansion in the pipeline industry and all these factors have made research into the causes and prevention of corrosion advisable.

The symposium was logically arranged to follow the oil from well to consumer, so the second paper was on the subject of " The Corrosion of Marine Structures and its Prevention," by G. T. Colegate, of the Compañía Shell de Venezuela. In many ways this proved to be a most surprising paper. The author described the corrosion of steel structures used in oil production in Lake Maracaibo, Venezuela, and the measures taken to mitigate this extremely severe corrosion. Lake Maracaibo may well be the most corrosive body of natural water in the world and it presents what has been described as the world's worst corrosion problem.

In the upper 20ft or so of the lake, the average general corrosion on steel piles, &c., as distinct from the pitting rate, is about fifteen times as great as the generally accepted rate for sea water. However, instances are fairly often found, both in the upper water and in that near the bottom of the lake, where the rate is increased to about twenty-five times that of sea water. The problems of cathodic protection have been found to be many times more difficult in this lake water than in sea water.

For the next two sessions the chair was taken by Leslie Kenworthy, the present chairman of the Corrosion Group which now has 557 members, and his long service with the Admiralty made this doubly appropriate because the next paper was on the " Corrosion of Tanker Hulls and its Prevention," the authors being J. G. Robinson and K. Fleming, of Shell Tankers, Ltd.

There may be 20 acres of steel surface exposed to corrosion in a modern tanker, and for one ocean-going fleet of some 200 ships it has been estimated that if no remedial measures were taken, the annual cost of corrosion would be about £2,000,000. Asked by Dr. W. H. J. Vernon what the cost of the remedial measures were, Mr. Robinson replied : 10 to 15 per cent. Distinction must be made between ships in white-oil service which involves carriage of light products such as gasolines, kerosenes, &c., and those which carry black oils ; for instance, fuel oils and crude oils.

The paper described the corrosion observed in tank spaces; hulls, rudders, stern areas and propellers ; and superstructures. Then, dealing with the scope and application of methods for controlling corrosion, it was stated that there was little prospect of using other constructional materials. Hence, emphasis must be laid on the elimination of factors affecting corrosion, the use of inhibitors, protective coatings and cathodic protection.

The great magnitude of the problem should be appreciated ; there were over 750,000 square feet of surface in a modest sized 18,000-ton tanker, more than half in the confined and complex structures of the cargo tanks. Owing to the difficulties of shot-blasting the steel plates *in situ*, the authors said that mechanical wire-brushing offers an immediate practical proposition.

That observation raised the additional comment in the discussion that test cleaning of steel plates had been carried out, with a number of different gauges and chemical compositions of wires for the mechanically rotated wire brushes. These tests had been reported in the fifth report of the Iron and Steel Institute's Corrosion Committee, pages 356 to 359. The wires of the brush must be hard enough to cut the steel plate and it was definitely advantageous to have the direction of rotation meeting the edge of the untouched scale, throwing it up and away and so not permitting the scale to be beaten by the brush into the surface of the steel.

The first day's technical sessions were then concluded by a paper written by H. B. Footner, of Shell International Petroleum Company, and P. W. Heselgrave, of Spencer and Partners, entitled " Developments in the Protection of Storage Tanks and Pipelines." As matters of interest in connection with this subject, Dr. Footner pointed out that well-established and reliable painting systems were sometimes replaced by white, pale grey or other pastel shades, dictated by fashion and appearance rather than serviceability, for the external painting of storage tanks. Many crude oils show no tendency to cause corrosion of storage tanks. Serious corrosion does occur, particularly below liquid level, in tanks used for tetraethyl lead blending. Internal corrosion of products pipelines and of terminal pipelines has caused concern and a variety of methods have been used and proposed for preventing it. As for the corrosion of the external surfaces of pipelines, the combination of good coating and cathodic protection is the best method of ensuring a long, leak-free life to buried pipes. More than 100 miles of bare line has now been cathodically protected in the United Kingdom.

On the following morning, still under the chairmanship of Mr. L. Kenworthy, two

papers were presented and discussed. They gave the points of view of the plant manufacturer and of the users in regard to corrosion prevention in salt water cooling systems. Dr. T. P. Gilbert, of Yorkshire Imperial Metals, Ltd., showed some very instructive lantern slides of coloured photomicrographs of metals to illustrate parts of his paper on "Corrosion Problems Arising in Tubular Heat Exchange Equipment." E. D. Dolan, of British Petroleum, Ltd., gave the users' point of view based on his own practical experience. In the discussion, Mr. Page showed illustrations of impingement attack at the top ends of the tubes, the lodging of mill scale in the ends of the tubes soon after they had been put into service, and a diagram which made clear that there is a remarkable peak in the pollution of the Thames river water at low tide. Several references were made to the present-day wide use of metal spraying and to the need for informed advice on how to paint sprayed metal.

As regards cathodic protection, the advent of titanium anodes coated with a tenth of a mil of platinum or tipped with platinum, now offers notable advantages; copper-cored, platinum-coated titanium wire may be used for a protective anode down the centre of a tube.

In the afternoon of the second day of the symposium, the chair was taken by E. W. Greensmith, who now serves as chairman of the Chemical Engineering Group of the Society of Chemical Industry. There were three papers and the first of them, on "Non-Destructive Testing," was introduced in a very pleasing manner by L. Wilkinson he and his co-author, P. S. Cotton, having in mind their practical experience at Fawley for Esso Petroleum Company, Ltd. This was also a businesslike paper and it evoked a useful discussion. It described the use of many methods of non-destructive testing which are widely known among engineers, but here they might have to be employed where serious risks of fire or explosion had to be ever in mind.

The last two papers dealt with "Developments in Corrosion-Resistant Materials"; the metals by G. L. Swales, of the Mond Nickel Company, Ltd., and the non-metallic materials by I. H. Thomas, of Shell Refining Company, Ltd., and T. S. McRoberts, of Shell Chemical Company, Ltd. It seems clear that the bulk of the oil companies' plants will still be made of steel but a number of costly special alloys have proved to be justified in key spots of trouble, where the normal ratio of noble to less-noble metal may be changed. In some cases, for example, valve plates made from titanium had proved to be highly successful, and the good resistance of zirconium to acids, especially HCl, was being noted with an interest which may become practical should its price fall.

During the discussion, it was pointed out that corrosion should not be considered without reference to the abrasion and erosion which may accompany it in service. Under abrasive conditions, the slow-rusting low-alloy steels may corrode as fast as mild steel.

Tables in the last paper gave the properties of plastics, at ordinary temperatures, in comparison with commonly used metals. Details were given of natural rubber and neoprene, carbon or graphite (resin-impregnated), stoneware, glass and plastic pipes. Much is now being done to ascertain how the multitude of new materials may possibly be used to increase the useful life in service of all types of plant in the petroleum industry.

In due course, the papers and the discussion, will be published as one of the monographs of the Society of Chemical Industry.

# Nuclear Reactor Simulator for Training

WE illustrate a nuclear reactor simulator and a reactor-core model which have been developed by Vickers-Armstrongs (Aircraft), Ltd., at the company's South Marston Works, Wiltshire. They are designed to meet the need for advanced nuclear training equipment within the means of universities and technical colleges. Their primary function is to supplement lectures on reactor kinetics, to train potential operators and to stage reactor experimental programmes.

As can be seen on the left of the illustration the simulator is a desk-mounted assembly. Essentially it is an analogue computer made up of electronic circuits which continuously solve the equations relating neutron flux with reactivity and time in a nuclear reactor. Any thermal or fast fission reactor running at low power can be simulated throughout its power range up to 100kW on the Mark I simulator illustrated. To keep this equipment simple it was decided that it should not be equipped to simulate effects such as variation of reactivity with temperature, fission product poisoning and fuel depletion which are characteristic of reactors running at higher powers. But more sophisticated simulators, Mark II and Mark III, are projected to simulate conditions such as those just mentioned.

**Nuclear reactor simulator and reactor core for training students and operators; these equipments are developed and made by Vickers-Armstrongs (Aircraft), Ltd.**

In the Mark I simulator the necessary power packs and d.c. amplifiers (the analogue computing elements) are contained in the compartments on the two side pedestals of the kneehole desk. Three inclined panels mounted side-by-side contain all the instrumentation. The left-hand panel carries the preset controls for setting up the characteristics of the reactor that is being simulated. The right-hand panel carrries the operational controls for the reactor. The central panel carries the indicator/recorder.

*Preset Controls.*—In the lower left-hand corner of the preset control panel is a neutron kinetic chassis under a hinged transparent cover. This chassis houses the controls that are preset in accordance with the characteristics of the reactor and it embodies the electrical network whereby the neutron kinetic equations are continuously solved.

A simulated source of neutrons enables a low power rate to be maintained when the reactor is shut down: a ten-turn helical potentiometer covering a range of 0–100mW simulates this condition. A four-way switch provides for selection of one of three fissile fuels ($^{233}U$, $^{235}U$, and $^{239}Pu$) as well as a hypothetical fuel; the latter allows for demonstration of the effect of delayed neutrons when they are gathered into a single group of average delay time.

Excess reactivity is provided by a potentiometer to control the magnitude and a key switch to determine, by its position, the sign of the quantity.

There are two controls which inject into the computing system a chosen quantity to indicate the mean lifetime of the neutrons emitted by fission in the fuel (the "prompt mean life").

*Reactor Controls.*—The reactor controls are grouped on the right-hand panel. They simulate control of reactivity by varying the position of shut-off rods and control rods. At the top of the panel there are position indicator lamps for the shut-off rods. Red is shown when the rods are fully out; and green and amber together, when the rods are ready to be withdrawn or partially withdrawn. Likewise the control rod lamps show red when the rods are moving or displaced from fully "in"; and green together with amber when the rods are fully in and ready to be withdrawn. There are "coarse," "fine" and shut-off dials with pointers to show the position of the rods between fully in and fully out.

An interlock ensures that the control rods can be withdrawn only when the shut-off rods are fully out, under the control of a push button. The control rods are moved by a dead man's handle at the foot of the panel. This lever is centrally biased towards the stop position and is deflected to right or left to move the rods out or in, the rate of movement being proportional to the deflection of the lever.

Left of the lever is a control rod release button whereby the reactor can be shut down partially, producing an instantaneous change in reactivity and returning the coarse and fine dials to zero. Complete shut down is effected

by another push button at the top of the panel.

*Instrumentation.*—In the control panel of the console there is a single-pen indicator-recorder showing the power output of the simulated reactor. Any one of four linear power ranges (0–100W to 0–100kW) or the logarithmic scale (covering six decades) can be selected by a range switch. The logarithm of the power level is continuously shown on a meter (covering six decades from 0·1 to $10^5$W) in the left-hand panel. Doubling time is indicated on a meter at the top of the left-hand panel, scaled from +5 seconds→∞→−25 seconds.

The Mark I simulator is equipped with interlocks and trip warnings to simulate safeguards against conditions such as accidental criticality, excessive power and no-power level, and too rapid increase of power, corresponding to doubling time less than five seconds. The equipment includes trip indication and reset buttons, audible alarm and cancel alarm buttons. The excess reactivity or power trip is subject to an "override" switch.

*Reactor-Core Model.*—The reactor-core model (illustrated) typifies the cross-section of a graphite-moderated reactor. It contains cut-off rods, control rods and fuel elements represented by coloured strip lighting to give a visual representation of events in the core. The shut-off rods and control rods are driven to move in synchronism with the controls and indicators on the simulator or on a separate control console. The lighting intensity of the fuel elements can be varied in response to a power level signal from the simulator or the model control console; the fuel elements are at maximum brightness at full power on the reactor.

*Experiments.*—Typical experiments that can be carried out on the simulator include approach to criticality; reactor start up and levelling-off procedure; critical setting by measurement of doubling time; step changes in reactivity; doubling time and reactivity; calibration of control rods; and shut-down power level.

# Pig Iron from Reclaimed Scrap Steel

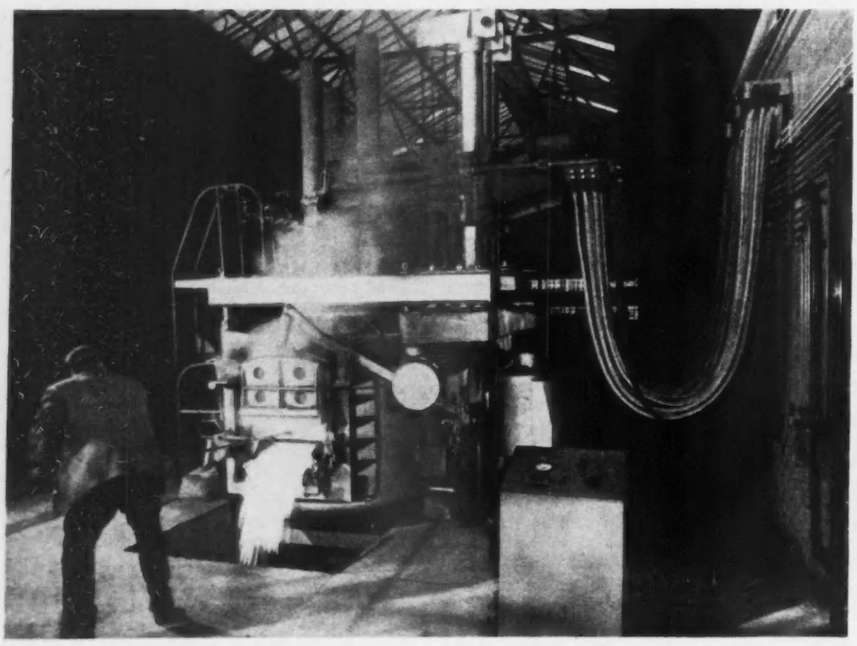
A NEW "Birlefco" 3-ton electric arc furnace has been installed in the works of Ferranti, Ltd., at Hollinwood, Manchester, to enable reclaimed scrap steel to be used in the production of a variety of cast iron materials made in the company's foundry. This scheme is expected to be more economical than the former practice of buying pig iron from an outside source. Although electric-arc furnaces are commonly used for making steel from scrap metal the production of pig iron from reclaimed scrap steel is a departure from normal practice, and it is believed that Ferranti, Ltd., is the first heavy electrical engineering company in Britain to institute such a scheme.

The scrap to be used consists basically of croppings from transformer laminations and other mild steel. To this material will be added back scrap from the foundry, together with a recarburising compound. This addition will take the carbon from the low figure of about 2 per cent up to the desired 3–3½ per cent and the steel will become cast iron on the addition of silicon and manganese, the actual amounts depending on the grade of cast iron to be produced.

One of the special materials to be produced in the new furnace will be "Nomag," a non-magnetic grey cast iron which was developed by the company's foundry department in 1923. Because of its non-magnetic properties it is widely used by British alternator manufacturers for stator end plates. It has a high nickel and manganese content and is an austenitic cast iron with reasonably high strength. "Nomag" also has a high specific resistance and is used for the manufacture of resistance grids. It is anticipated that about 50 tons of "Nomag" will be produced monthly in the new furnace.

Spheroidal graphite iron (a newer cast iron possessing the equivalent strength of mild steel) will also be produced in quantities of about 60 tons per month. By suitable heat treatment the strength can be varied from 25–60 tons per square inch. It is also ductile, with an elongation varying from 2 to 25 per cent according to grade. It was first developed by the British Cast Iron Research Association in 1948.

In processing S.G. iron, the treatment (involving the addition of magnesium alloy to the molten metal to change the graphite from flake to spheroidal form) can be rather expensive. The amount required is dependent on the initial sulphur content of the metal, and the lower the sulphur content the less magnesium alloy required. As scrap croppings of transformer laminations contain about 90 per cent pure iron and only 0·02 per cent sulphur, substantial savings should result because much less magnesium alloy will be required.



**3-ton, 1600kVA Birlec arc furnace installed in the foundry at the Hollinwood works of Ferranti, Ltd.**

Another cast iron product will be "NoduMag" Basically, it is "Nomag" with spheroidal graphite, and has the same general electrical and non-magnetic properties but with much higher strength—approximately 28–30 tons per square inch tensile strength and elongation of 15–20 per cent. It is anticipated that about 30 tons of "NoduMag" will be produced monthly.

The Ferranti foundry department also produces a high strength flake graphite cast iron with tensile strength in the region of 17–18 tons per square inch.

Close control of composition is exercised with the help of a recently acquired Strohlein apparatus, which can determine simultaneously the carbon and sulphur content of a sample obtained from the furnace within five minutes. Immediately after S.G. iron is treated with the addition of magnesium alloy a sample is taken. It is polished and examined under a microscope to determine that the graphite is in spheroidal form, and it is then checked on the Fuess spectroscope to ensure that the residual magnesium is not too high. Test bars are also cast from all the different kinds of cast iron produced in the foundry.

The new "Birlefco" 3-ton capacity 1600kVA electric-arc furnace installed in the foundry consists of a cylindrical, refractory-lined, bowl-shaped shell of 7ft diameter with three triangularly spaced electrodes projecting vertically through the removable roof and connected through flexible cables to a furnace transformer. The roof ring in which the roof refractories are seated is water cooled, as are the electrode arms and clamps in which the 8in diameter by 6ft long electrodes are held.

Winch motors and counterbalanced wire ropes are provided for feeding each electrode under the control of an amplidyne regulator which maintains a constant arc and a high average power input. Pouring is simplified by a tilting screw mechanism which can be operated either manually or by an electric motor. The furnace tilts on toothed rockers, up to 45 deg. in the forward position for draining the molten metal from the shell, and up to 15 deg. backwards for slagging-off. Batch melting by this electric-arc furnace takes about one to one-and-a-half hours, and the furnace is charged from the top by an overhead crane.

The electrical equipment (which includes a circuit breaker, transformer, amplidyne set and furnace control panel) is installed in an enclosed substation next to the furnace. This control panel is divided into high- and low-voltage sections and is equipped with a Honeywell Brown furnace temperature indicator and Ferranti instruments, including ammeters, voltmeters, wattmeters, and kilowatt-hour meters.

The 1600kVA, three-phase Ferranti furnace transformer is provided with variable reactance to ensure stable operation of the arc over a wide range of furnace secondary voltages from 230V to 95V, and to limit the short circuit current which could be caused by an electrode coming into direct contact with the metal charge. The transformer off-load tapping switch is interlocked with the circuit breaker to ensure that the circuit breaker will be tripped if manual operation of the tapping switch is attempted with the transformer live. Other interlocks ensure that the circuit breaker cannot be closed except when the tapping switch is in an operating position and that the circuit breaker cannot be closed unless the furnace roof is in position.

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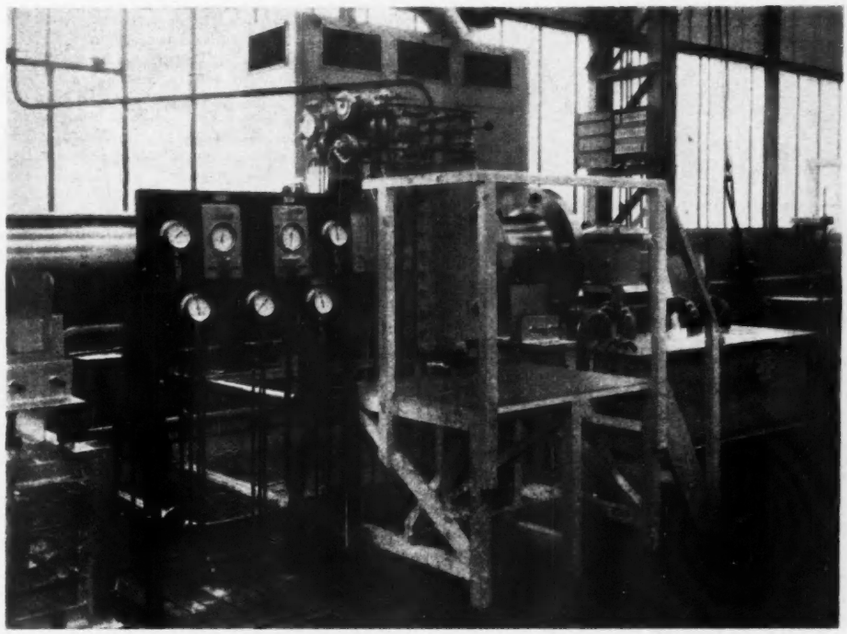
DIESEL HYDRAULIC LOCOMOTIVE.—A 204 h.p. diesel locomotive with hydraulic transmission is now made by the Hunslet Engine Company, Ltd., Jack Lane, Leeds, for shunting and general purpose services. This new 0–6–0 locomotive with a weight in working order of 30 tons, is powered by a Gardner 8L3 diesel engine and has a "Hunslet" hydraulic transmission in place of the four-speed mechanical gearbox previously employed on the firm's locomotives. It has a starting tractive effort of 20,700 lb and a maximum of 12 m.p.h. The single-stage torque converter is designed for a relatively low torque multiplication, and to be capable of long continuous slow speed working with heavy loads.

# Large Controllable-Pitch Propeller

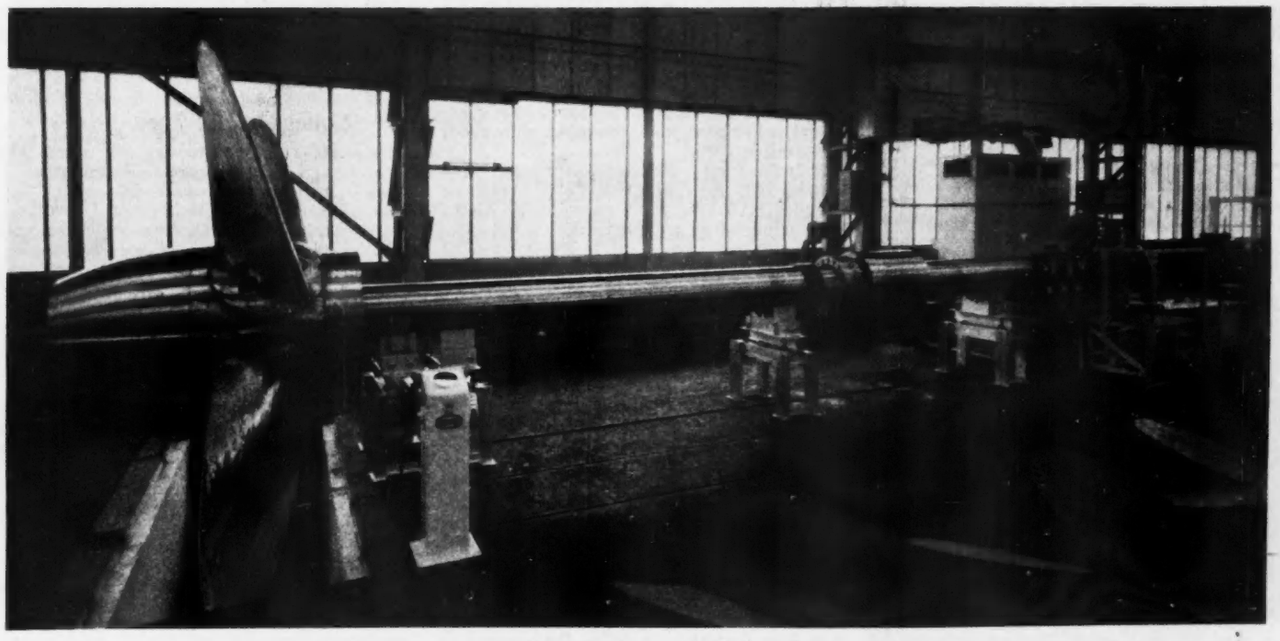
DURING the last fifteen years the Stone Marine Engineering Company, Ltd., as it is now known, has been manufacturing controllable pitch propellers, both of Stone-Kamewa and of its own design, at the Charlton works of its associate company, J. Stone and Co. (Charlton), Ltd. Up to the present some seventy-five propellers transmitting over 100,000 h.p. have been supplied and one of the earlier installations, namely, a three-bladed propeller of 9ft 4in diameter, fitted to the collier "Wandsworth" was described in THE ENGINEER of July 14, 1950. We recently paid a visit to the works to see the latest unit which the company has built under licence from Aktiebolaget Karlstads Mekaniska Werkstad of Sweden. This is the largest controllable pitch propeller built at Charlton and was ordered by Smith's Dock Company, Ltd., for a cargo ship being constructed for the Bolton Steam Shipping Company, Ltd. This ship has a length of 460ft, a beam of 63ft, a draught of 27ft 6in, a displacement of 16,900 tons and a service speed of 13 knots. Propulsion will be by a Free Piston gas turbine machinery installation developing 4000 s.h.p. and driving the 16ft diameter four-bladed controllable pitch propeller at 110 r.p.m. The blades, each of which weighs 28¼ cwt, and the hub are in bronze, the hollow bore shafting is of steel and the main control and oil distribution box are of cast iron, while the total weight of the equipment is approximately 38 tons. The adoption of this design of propeller in conjunction with free piston gas turbine machinery avoids the necessity of incorporating an astern turbine and thus eliminates its associated windage and heat losses and also the need for gas flow proportioning valves.

Change of pitch is effected hydraulically by a piston inside the propeller hub, the axial displacement of the piston turning the propeller blades by mechanical linkage; thus all the loads required to change blade pitch are confined to the boss mechanism. Oil to operate the piston is fed under pressure through a tube in the shaft bore to a regulating valve in the hub which controls the flow to one side or other of the piston. Oil displaced during pitch changing is returned between the tube and the bore of the tailshaft. The oil distribution box is mounted on the shaft and acts as a means of feeding pressure oil into and return oil out of the shaft to the supply tank. The oil distribution box is illustrated herewith showing the pneumatic/hydraulic control gear and local hand lever control. The tube which supplies the oil also actuates the hub servo-motor and regulating valve controlling the piston and its movement is controlled by a servo-operated fork mechanism actuating a sliding collar on the shaft, keyed to the end of the control tube through a slot in the shaft. Our illustration is of the propeller under test in the new bay recently added to the propeller shops and shows the single lever pedestal control and also the S.K.F. coupling which incorporates a tapered sleeve and a hydraulically-operated mounting tool.

Pressure oil to power the system is provided by two electrically-driven Mirrlees pumps which draw their supplies from a tank near the distribution box to which the oil is returned after being exhausted from the shaft. One of the pumps runs continuously to maintain the oil under pressure while the other runs free until it is automatically coupled in when pitch changing is being carried out. The whole system is maintained at slightly over external hydrostatic pressure by a header tank so that there can be no ingress of sea water into the system. In the event of a failure in the operating mechanism a group of nine safety springs are arranged circumferentially in the hub and these operate directly upon the piston in the hub to return the blades to the full ahead position.



**Oil distribution box showing pneumatic/hydraulic control gear and local hand lever control**



**Four-bladed, controllable-pitch propeller to absorb 4000 s.h.p. at 110 r.p.m.**

# SHORTER REPORTS

## Scientific Research and Man-power

THE Advisory Council on Scientific Policy's Annual Report for 1958–59 (Cmnd. 839, H.M. Stationery Office, price 1s.) was published on December 8. The Council is a Standing Committee which advises the Lord Privy Seal and Minister for Science.

The Council has drawn attention to certain principles which it believes should underlie British participation in space research. While it believes that carefully designed experiments using earth satellites can contribute to the answer of a number of important scientific problems, and in many cases may well prove the most economic method of obtaining the required data, it considers that the cost of venturing into space with lunar, planetary or solar probes would be too great for this country's resources and would not be likely to yield results commensurate with the cost. The Council believes that British science and technology have much to contribute in the field of space research but that the United Kingdom's contribution should be part of an internationally-based approach. It therefore considers that every effort should be made to establish such an international co-operative effort and for this reason welcomes the agreements reached with the U.S.A. and Canada as a step towards this goal.

### SCIENTIFIC AND ENGINEERING MAN-POWER, 1959*

The Lord Privy Seal and Minister for Science has presented to Parliament a report by the Advisory Council on Scientific Policy's Committee on Scientific Man-power entitled "Scientific and Engineering Man-power in Great Britain, 1959" (Cmnd. 902, price 3s.). This brings up to date the information contained in a previous report published jointly by the Advisory Council and the Ministry of Labour and National Service in 1956, which was based on an inquiry by the Ministry into the number of qualified scientists and engineers in Great Britain, and the employers' forecasts of requirements by 1959.

The present report indicates that the employment of qualified scientists and engineers increased at a rate of about 6 per cent a year during the period under review (1956–58). Employers have stated that they would like to achieve an increase of 7 per cent during the next three years (1959–61).

More scientists and engineers qualified during the three years, 1956–58, than the Committee thought would be possible in 1956 (41,000 as compared with a forecast of 36,000). But at the beginning of 1959 employers reported over 6000 vacancies in manufacturing industry alone. During the three years, 1959–61, the Committee estimates that over 51,000 scientists and engineers will qualify but that the numbers available for employment in Great Britain will still fall short of employers' forecasts of requirements.

No attempt has been made to forecast demand for the different kinds of scientists and engineers beyond 1962, since employers cannot be expected to predict their requirements in detail for more than a few years ahead. Nor could universities and technical colleges forecast the output of scientists and engineers by subject of qualification beyond the point in time when students now in training are expected to qualify because output will depend, to a large extent, on the wishes and earlier education of students seeking admission. The Committee also considered that it would be premature, on the evidence of information obtained from two surveys, to reassess their forecasts of long-term demand looking ten to fifteen years ahead of the kind which they attempted in 1956. They will, however, continue to keep a close watch on developments which may affect previous estimates.

The report states that in January, 1959, there were about 173,000 scientists and engineers in all fields of employment, comprising 72,200 scientists and 100,800 engineers. This estimate shows an increase of nearly one-fifth (28,000) in the numbers employed early in 1956. In addition there were over 43,000 holders of Higher National Diplomas and Certificates in 1959. In the fields of employment covered by the 1956 and 1959 inquiries, the number of scientists and engineers rose by 23,600. Of this increase 63 per cent went to private manufacturing industry, 13 per cent to the nationalised industries, 5 per cent to central and local government and 17 per cent to education. Expressed as a proportion of the working population the number of scientists and engineers increased from six to seven per 1000. The report also includes an analysis of scientists and engineers by subject of qualification. In 1959 there were 63,200 scientists and 89,200 engineers and the forecasts of requirements by 1962 would call for an increase of 20·6 per cent in the scientists, and 22·7 per cent in the engineers on the 1959 figures.

In 1956 the manufacturing industry reported that it aimed to employ 37 per cent more qualified scientists and engineers in the next three years. The present report shows that although industrial production during the period was relatively stable, the number of scientists and engineers in manufacturing industry increased by 30 per cent. If vacancies still outstanding at the beginning of 1959 are taken into account, recruitment plus vacancies slightly exceed the 1956 forecast of requirements by 1959.

The experience of different groups of manufacturing industries varied widely. In some, notably the chemical and allied trades, the plant and machinery group, precision instruments and shipbuilding the recruitment of scientists and engineers substantially exceeded the industries' forecasts of their requirements; in others, principally electrical engineering, metal manufacture, motor vehicles, and aircraft, the increase was appreciably less than forecast.

Of the qualified scientists and engineers employed in manufacturing industry 41 per cent were shown to be engaged on research and development compared with 44·5 per cent in 1956. It was estimated that about one-quarter of all scientists and engineers engaged on research and development in industry and in Government research establishments were employed on defence work compared with about two-fifths in 1956.

Manufacturing industry estimated that between 1959 and 1962 it would need to increase its stock of scientists and engineers by 27 per cent, representing an additional 17,200, compared with the increase of 14,750 in 1956–59. Of industries employing a substantial number of scientists and engineers those which looked for the greatest increases were electronics, metalliferous mining, machine tools, miscellaneous metal goods, motor vehicles, constructional engineering, aircraft, heavy electrical engineering and metal manufacture.

Among the nationalised industries the Atomic Energy Authority showed the largest increase in the numbers of scientists and engineers during the period 1956–59 (71 per cent). The Authority looks for a further increase of 42 per cent on the 1959 figures by 1962. Of other nationalised industries, the Electricity Authorities hoped to recruit 35 per cent, and the British Transport Commission 29 per cent, more scientists and engineers in the next three years.

Government departments made a smaller claim on the pool of scientific man-power than had been expected in 1956, the increase in number being only 7½ per cent compared with a forecast of 14 per cent. This was mainly because the number employed in the defence departments remained unchanged. Forecasts for 1962 show a reduction of 2 per cent on the 1959 figures in the requirements of the defence departments and increases of 12 per cent for the civil departments and 16 per cent for the research councils. Local authorities (excluding local education authorities) appear to have been unsuccessful in meeting their needs between 1956 and 1959 and their estimates for the next three years include a high proportion of current vacancies.

The report stresses the special difficulties of the schools in recruiting an adequate number of science teachers and says that the increase between 1956 and 1959 fell far short of requirements. The position should be easier after 1962, when school rolls are expected to fall and when there should be more teachers available from the larger number of scientists leaving the universities.

Universities, technical colleges and teacher training colleges have made good progress between 1956 and 1959 in meeting their growing need for more scientists and engineers. In universities the number increased by 28 per cent and in other higher educational institutions by 23 per cent. Forecasts of requirements by 1962 indicate that increases on the same scale will be needed.

About 20,000 scientists and engineers are engaged on defence, a smaller proportion of the total number than in 1956. In research and development, the proportion engaged on defence work in industry and government research establishments is about one-quarter as compared with something like two-fifths three years earlier.

By 1962 about 211,700 qualified scientists and engineers will be needed to meet employers' forecasts of requirements, an increase of 38,700 on the 1959 figures. Another 14,400 will be needed to compensate for wastage, making a grand total of 53,100. On the basis of the information available, after allowance has been made for those emigrating or returning to their homes overseas, it is estimated that the numbers available for employment in this country will be reduced to about 47,500, which is over 5000 less than the estimated requirements. The shortage of mathematicians, physicists and chemists is likely to continue though there are indications that the supply of some kinds of biologists might exceed the demand.

* For the purpose of this report the term "qualified scientists and engineers" includes university graduates, holders of the Diploma in Technology (National Council for Technological Awards), associates of certain educational institutions, and graduate or corporate members of the main professional institutions (see Appendix I of the Report).

## College of Technologists

DETAILED arrangements for the award of "Member of The College of Technologists" (M.C.T.) have been announced this week by the National Council for Technological Awards. This award follows the Diploma in Technology and is given to those who complete a substantial programme of work of value to industry carried on jointly in industry and a college. Lord Hives, chairman of the National Council and of the Court of Governors of the College of Technologists, commenting on the arrangements, said that the new higher award, with its own distinctive features, provided a qualification in the field of technology equivalent to the Ph.D. degree of a university and would be welcomed by students, technical colleges and industry alike. The award carried into the field of research that close relationship between academic work and practical experience which was one of the distinguishing features of the Diploma in Technology.

A memorandum issued for the guidance of applicants for the award and of colleges and industrial organisations concerned, sets out the principal points, as follows: a programme of work must be satisfactorily carried out jointly in industry and at a college; the programme may

be concerned with any technological aspect of industrial activity, examples being research, development, design, production and market investigation ; the programme must be one which is likely to result in a useful contribution to technological knowledge and must also require industrial experience and academic study extending over a substantial period ; the period of study which the College of Technologists has in mind is three years, provided that a high proportion of this time is spent on work acceptable for membership of the College.

A high standard is demanded for candidates for membership of the College. Those who may register include holders of the Diploma in Technology and others who have an equivalent qualification. Representatives of the Board of Scientific and Industrial Studies of the College may want to visit the technical college and industrial organisation concerned to see the facilities available for carrying out the proposed programme of work and to discuss the programme with the student and his supervisors. The department of the technical college concerned must already be conducting at least one course leading to the Diploma in Technology. Exceptions may be made in the case of departments of a high standing which are conducting courses of equivalent standing and have strong links with industry at the post-graduate or post-diploma level. The technical college submitting the candidate's application for registration will be responsible, with the industrial organisation concerned, for his final examination. This must include an oral examination. The College of Technologists has to approve the examiners proposed and at least one external examiner approved by the College must be included in the list of examiners.

Copies of the memorandum can be obtained from the College of Technologists, 9, Cavendish Square, London, W.1.

## Automatic Control in Soviet Industry

THE report has been published of a team of six British engineers who visited the Soviet Union in May this year to study progress in automatic control applied to industrial production. Visits were made to research institutes, teaching institutions and a few factories in Moscow, Leningrad and Kiev, but it is not known what proportion of the total activity in this field by the Soviet Union and its associates was seen and so it is emphasised that conclusions as to the general position must be quite tentative. A request was made by the team for some kind of list or directory of the institutes concerned with automatic control, but this was not forthcoming.

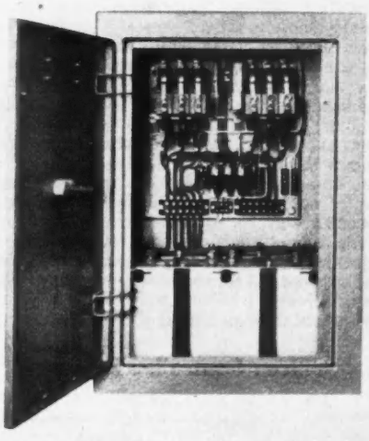
Work seen at the various establishments visited covered a wide variety of industrial and scientific techniques. Electronic analogues are being used for numerous purposes, such as studying the behaviour of an automatic gauge control system for cold reduction tandem mills, and the study of stability in power systems. In the latter connection an extensive installation at the Institute of Electromechanics, Leningrad, is described, which has been in use for investigating stability problems in the project for power lines connecting Moscow to Kubishev (560 miles), and to the Urals (621 miles) ; and also from Moscow to Stalingrad (621 miles) and Stalingrad to Donbas (373 miles). The main analogue machines are about 3ft in overall diameter, specially designed and operating very under-rated, to simulate the parameters of the actual alternators. There are electronic simulators for the turbine characteristics and also for the voltage regulator. The regulators and protective systems actually used in service may be connected to the model, since it is a true time scale analogue. Studies of automatic control for furnaces of various kinds were seen at the Institute of Automation of the Ukraine and the Central Laboratory for Automation in Moscow. In connection with automatic control based on roof temperature measurement in open hearth furnaces, a scanning pyrometer has been developed using a vacuum photocell and a standard filament lamp which is brought automatically to a brightness match with the surface viewed. The pyrometer unit with electronic head amplifier, lamp, photocell and chopper and appropriate optics are all built into a cylindrical form about 2in diameter and 15in long. Control can be given on the highest temperature reading.

The general conclusion of the team is that work on industrial control system development is at present not so advanced as in Britain, but great potential is being built up for further progress and the effort being made in engineering education is massive and effective. The report also includes a note on a visit to Poland by Professor A. Tustin on the return journey from the Soviet Union. He observes that work so far is more preparatory than effective in actual industrial application, perhaps because the bonuses for managers in industrial plants depend at present more on the number of persons employed rather than the technical level of engineering involved.

Reproduction of the report was undertaken by the Department of Scientific and Industrial Research. Copies may be obtained on application to the Honorary Secretary, Group B, British Conference on Automation and Computation, c/o Institution of Electrical Engineers, Savoy Place, London, W.C.2 ; or to the Lending Library Unit (D.S.I.R.), 20, Chester Terrace, Regents Park, London, N.W.1.

## "Statormatic" Starters for Squirrel-Cage Motors

A SQUIRREL-CAGE motor starter which is new to the United Kingdom is being introduced by Lee Guinness, Ltd., Newtownards, Northern Ireland. This starter makes use of an automatically variable resistance (an electrolyte with a negative temperature coefficient of resistivity) inserted in series with the stator winding to limit the starting current and maintain a smooth starting torque. Under a licence agreement with A.O.I.P-Berard (France) Lee Guinness, Ltd., has secured the sole manufacturing and selling rights for this starter—known as the "Statormatic"—in the United Kingdom and the Commonwealth, excluding Canada.



**25 h.p. "Statormatic" starter for starting of squirrel cage induction motors. Starting is automatically controlled by the resistance temperature characteristic of electrolyte in the three containers at the bottom**

The "Statormatic" starter embodies electrolytic liquid rheostats in place of the usual metallic resistances. Its action depends on the reduction in the resistance of an electrolyte when its temperature is raised. Over the designed temperature range used during the starting cycle the volt drop across the electrolyte, for a given current, decreases in the ratio 5 : 1.

The "Statormatic" starter (illustrated here) consists of a three-phase line contactor, a set of three variable electrolytic resistances (one per phase) and a second contactor which is under time control to short circuit the resistances at the end of the starting period.

Each of the three variable resistances consists of two electrodes partly insulated and immersed in electrolyte contained in a rectangular "Steatite" box which is of predetermined volume and is known as the "thermal chamber." The electrodes are partly insulated and the area of bare electrode is one of the factors that governs the resistance of the liquid at the beginning of the starting cycle. The volume of the thermal chamber is a function of the horsepower of the motor and of the required torque. Each thermal chamber is enclosed in a reinforced polythene tank which has a capacity of either 2 litres or 5 litres. There are orifices in the sides of the thermal chamber to allow free passage of electrolyte between the chamber and the tank. It is stated that the temperature of the electrolyte becomes uniform in the chamber and tank a few seconds after the starting cycle.

The starting cycle is initiated (with the short circuiting contactor open) by the line contactor connecting the liquid resistances in the stator circuit of the motor. The voltage on the stator and the resulting current and torque are thus limited to values predetermined by the calibration of the resistances. During starting the current raises the temperature and lowers the resistance of the electrolyte in the thermal chamber. The voltage at the motor terminals rises to its maximum value (85 to 95 per cent of the line voltage) at the end of the accelerating period. Then, to complete the starting cycle the short circuiting contactor is closed by the timer. The current peak at the instant of short circuiting of the resistances is comparatively small, being that corresponding to the imposition of 5–15 per cent of the line voltage on the stator.

On smaller starters timing of the contactor is effected by a thermistor connected in series with the contactor operating coil. But for frequent starting duties a separate solenoid-operated timer can be supplied. On larger starters a mechanical timer is fitted ; the timing cycle is initiated by the closing of the line contactor. The line contactor is a triple-pole equipment rated in accordance with B.S.S. 775 and equipped with thermal overload protection.

In designing the resistance to suit various motor characteristics the manufacturers vary the height of the thermal chamber and the length of the insulating sleeves covering the electrodes and make use of a choice of four electrolytes—potassium hydroxide (15 per cent solution), potassium carbonate (20 per cent solution), sodium carbonate (9 per cent solution) or sodium borate (9 per cent solution).

Up to 40 h.p. on 220V and 65 h.p. on 380V there is a choice between the ST2000 (2 litre) and ST5000 (5 litre) resistance units, the choice depending on the frequency and duration of starts. For greater horsepowers, up to 100 h.p. the S.T.5000 resistance units are used.

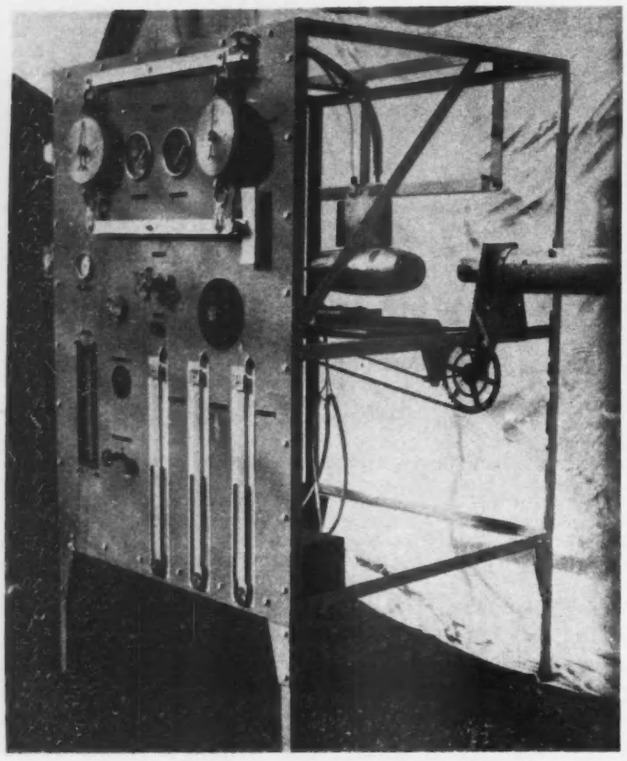
The manufacturer states that the only unfamiliar maintenance task is that of occasionally checking the electrolyte level, which is directly visible through the sides of the tanks. Ordinary water is used for topping up.

At present the resistance units are imported from France, but later they will be made by Lee Guinness, Ltd., in the United Kingdom.

[Reply Card No. E7891]

## I.E.E. Christmas Holiday Lecture

COLOUR television is the subject of the Christmas Holiday Lecture arranged this year by the Institution of Electrical Engineers, and to be held in the lecture hall of the Institution, Savoy Hill, London, W.C.2, at 3 p.m. on December 30 and 31. The lecture will be delivered by Mr. E. E. Gouriet. This is the fourteenth year in which the Institution has organised these lectures, which are planned to be of maximum benefit and interest to schoolchildren. The lecture will trace the evolution of colour television systems since J. L. Baird's demonstration in 1928 and will proceed to explain the advantages over previous proposals of the present technique of transmitting a luminance signal which can be received as an ordinary black-and-white picture, and a chrominance signal for colour viewing. The lecture will be illustrated with slides and demonstrations. Admission to the lecture is free, and application for tickets, stating the afternoon for which they are required, should be made to the Secretary of the Institution.



A 5in subsonic ramjet with a thrust of about 3½ lb can be studied in this test stand

## Instructional Heat Engine

THERE has been evolved by P. A. Hilton and Co., Sydneyville House, New Road, Radlett, Herts, an engine test bed for use in the training of student engineers. The engine is the least complicated of internal combustion units, a continuous-flow subsonic aerothermodynamic duct or ramjet : this example was originally developed for use on a helicopter rotor blade. The engine is mounted on a simple balance with two spring weighers to show thrust and drag, the balance being restrained by a hydraulic damper. The instrumentation consists of a pitot-static probe, cooled by mains water, which can be traversed along the axis of the engine by the sprocket chain with the appearance of a bicycle transmission in our illustration : manometers display the probe total and static heads and the free stream total head. The flow of fuel, propane gas from a pressurised container, is shown by a " Rotameter ": it is controlled by the handwheel in the middle of the panel.

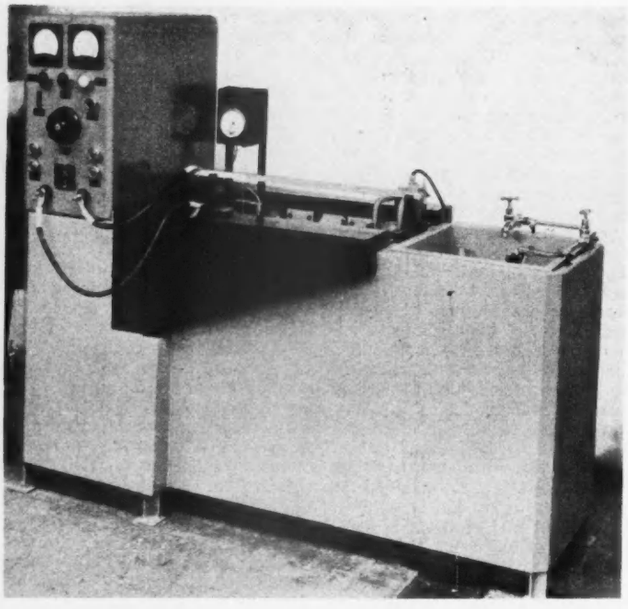
The engine requires a supply of air at 300ft per second from a 3in diameter nozzle : this will demand a blower of about 8 h.p., the blower being, of course, available for other experiments. The exhaust system consists of a stainless steel duct 11½in in diameter and 24in long, with deflector vanes at the tail end.

With the instrumentation described, it is possible to follow the variations of velocity and pressure through the cycle of compression, combustion and expansion. The first example is now being brought into use at the Aeronautical Engineering Department of the Imperial College of Science and Technology : in this case provision will be made to traverse a pitot across the intake and exhaust in order to derive the mass flow and hence the efficiency as a heat engine.

[Reply Card No. E7901]

## Hard Chrome Plating Equipment

A PRECISION hard chrome plating equipment made by the Coventry Gauge and Tool Company, Ltd., Coventry, is claimed to enable predetermined plate thicknesses to be controlled to within 0·0001in. This equipment uses what is known as the " Veriform " process, and the model shown in our illustration is designed to plate up to 50 square inches of surface area at a time. A particular application of the equipment is the hard chrome plating of precision components to render them resistant to wear and corrosion and where a close degree of dimensional control is essential.



Hard chrome plating equipment for precision plating components to limits controllable within 0·0001in

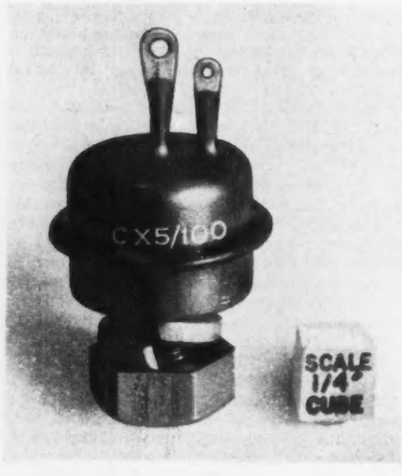
In the process a special chrome plating solution is used which, in conjunction with carefully controlled timing, temperature, and current density, deposits a hard skin of chromium well bonded into the base metal. This form of plating can be applied to base materials of plain and alloy steels, cast iron, copper base alloys and similar metals. It is not suitable for aluminium and its alloys or materials of the cemented carbide type. The chrome deposited follows the form and surface variations of the base component and there is stated to be no loss of micro-finish with highly polished components.

The equipment is designed for operation by personnel with precision engineering experience and does not call for the services of highly skilled platers.

[Reply Card No. E7902]

## Silicon Controlled Rectifier

A NEW silicon controlled rectifier has been developed to the preproduction stage at the Lincoln factory of the electronic apparatus division of Associated Electrical Industries, Ltd. It is expected that quantity production will begin in January next.




Typical A.E.I. silicon controlled rectifier

The new rectifier is a P-N-P-N assembly and can be regarded as two transistors coupled by a common collector junction ; it is the solid-state equivalent of the thyratron or the grid-controlled mercury-arc rectifier. It offers a high impedance (several megohms) in each direction, but can be triggered into a low impedance condition in one direction by the application of a small signal to the third electrode. Like other solid-state devices, it is small, as illustrated here ; it has a high efficiency and requires no heater supplies.

Applications are similar to those of the conventional devices, such as the control of electric motors, firing of ignitrons, d.c. to a.c. conversion, frequency conversion, phase-controlled d.c. power supplies, static switching, &c.

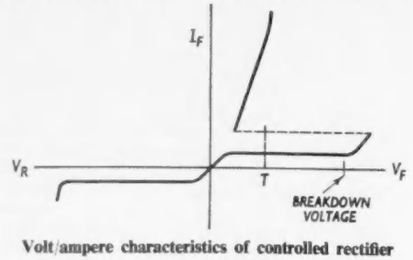
The present range of controlled rectifiers is tabulated here. Loads up to 10A at 25/300V peak inverse voltage can be handled.

*Ratings of A.E.I. Silicon Controlled Rectifiers*

| Rectifier, type | Peak inverse voltage, volts | Mean d.c. forward current, amperes |
|---|---|---|
| CX10/25 | 25 | 10 |
| CX10/50 | 50 | 10 |
| CX10/75 | 75 | 10 |
| CX10/100 | 100 | 10 |
| CX10/150 | 150 | 10 |
| CX10/200 | 200 | 10 |
| CX10/250 | 250 | 10 |
| CX10/300 | 300 | 10 |
| CX5/25 | 25 | 5 |
| CX5/50 | 50 | 5 |
| CX5/75 | 75 | 5 |
| CX5/100 | 100 | 5 |
| CX5/150 | 150 | 5 |
| CX5/200 | 200 | 5 |
| CX5/250 | 250 | 5 |
| CX5/300 | 300 | 5 |

Typical trigger requirements 50mA, 2V ; Typical forward volt drop, CX10 types, 1·5V ; Typical forward volt drop, CX5 types, 2·5V.

The volt/ampere characteristic of a controlled rectifier is shown in the diagram. In the reverse direction it is almost identical with that of a simple silicon rectifier. The forward direction is a mirror image of the reverse characteristic up




Volt/ampere characteristics of controlled rectifier

to the breakdown voltage. If a small current (10–100mA) is applied to the control electrode when the forward voltage is below breakdown (e.g. at $T$ in the diagram), the rectifier will remain conducting until the voltage across it falls to almost zero. A common practice is to control the output of the rectifier by changing the phase of the trigger current in relation to the a.c. voltage applied to the rectifier.

[Reply Card No. E7903]

## Radar for River Craft

A NEW 3cm radar system for navigation on inland waterways was demonstrated to an international gathering of European shipowners in Rotterdam last month by Decca Radar, Ltd., Albert Embankment, London, S.E.11. The equipment, known as the Decca 215 River Radar, comprises a scanner unit, a combined transmitter/receiver and a display unit, together with the associated power supply. Peak power has been doubled compared with the company's first river radar introduced in 1955 and two pulse lengths are now provided, 0·15 microsecond and 0·05 microsecond, the longer pulse providing strong echoes at the relatively long ranges necessary in estuaries and on stretches of open waterway. An additional control enables the operator to adjust the degree of differentiation applied to the radar picture in order to get the sharpest presentation practicable without suppressing wanted echoes under the differing topographical conditions encountered on inland waterways. The 400m range on this equipment is also new since the previous river radar was introduced. An optical magnifier with a magnification of 1·7 times is provided.

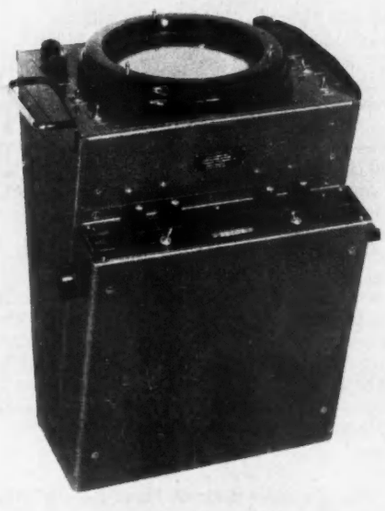


Fig. 1—Display unit of river radar installation with seven range scales, off-centring and magnification facilities

The display unit (Fig. 1) is suitable for installation on a pedestal although it is normally fitted to a bulkhead or deckhead to conserve space in the wheelhouse. Seven range scales of 0·4km, 0·8km, 1·2km, 1·6km, 2km, 5km and 10km are provided on a 23cm cathode ray tube; nautical and statute mile versions are also available. Each range may be off-centred by half a radius to provide increased warning ahead on the scale in use. The transmitter/receiver is a bulkhead-mounting unit which carries no controls and can be installed in any convenient position within 6m waveguide run of the scanner. Peak power is 20kW and the p.r.f. 1000 per second. The scanner is a horn-fed tilted parabolic cylinder of 2m aperture which rotates at 24 r.p.m. It may be installed on a retractable pole mast which can be lowered by one man in approximately twenty seconds. After re-starting, the display trace is aligned automatically to the aerial to within 5 deg., final adjustment being manual. The horizontal beam width is better than 1·2 deg. at low power points, and the side lobe level is stated to be extremely low. Power for the radar and scanner is provided by a 420W motor-alternator with separate voltage regulator.

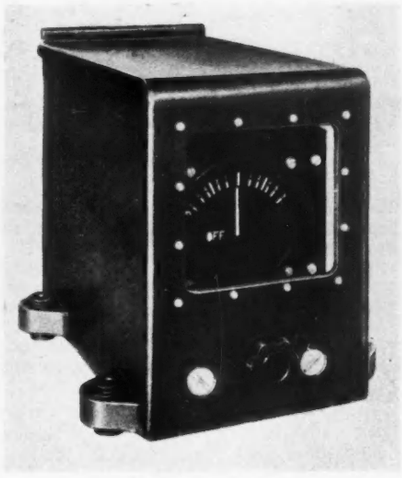


Fig. 2—Rate of turn indicator capable of detecting turning rates of the order of $^{1}/_{10}$ deg. per second

To replace the original Decca rate of turn indicator two further types have been designed to meet the agreed specification for such instruments issued by the Commission Centrale de la Navigation du Rhin. These provide the helmsman with an accurate and sensitive heading reference which is essential when steering by radar. The two types have different degrees of sensitivity for use in vessels with slow or fast swinging rates. Power supply for the indicator is provided from a small motor-alternator.

[Reply Card No. E7911]

## Anti-Squeal Brake Lining

A FRICTION material with a reduced proneness to squeal has been evolved and extensively tested by Gandy, Ltd., Wheatland Works, Wallasey, Cheshire. The new material is bonded with an elastomer instead of the usual resin, and hence vibrations excited at the friction face are damped in transmission to the shoe and brake mechanism. Further, the water absorption is less than in normal moulded materials, and we are advised that field trials have shown that it dries out more quickly than usual, particularly on motor cycles.

The new material has a friction coefficient of 0·33 up to 450 deg. Fah. falling to about 0·29 at 600 deg. Fah., the maximum tolerable. The lining is soft enough for use with all conventional drum materials without scoring and to be supplied in rolls for cutting into linings.

[Reply Card No. E7912]

## Closed Circuit TV for Bank Branches

CLOSED circuit television for document viewing was introduced between three branches of the Westminster Bank, Ltd., in Manchester on December 3. This is the first system of its kind in Britain to connect different branches of a bank, and has necessitated the provision by the G.P.O. of two vision cable links with lengths of 0·4 mile and 0·8 mile respectively. The television equipment has been supplied by the Industrial Television Division of Pye, Ltd., Cambridge.

We illustrate the camera and control panels at the York Street office of the bank, where the centralised book-keeping department is situated. At present this is connected with 14in television screens in the managers' rooms at the Royal Exchange and Knott Mill branches, and also with a private viewing cubicle for customers at the Royal Exchange branch. The Corn Exchange branch of the bank will shortly be added to the circuit. The camera contains a staticon photo-conductive tube mounted horizontally and looking downwards by means of a mirror at cheques and other documents placed on the desk. In this form of tube the image is focused on a photo-conductive target, the opposite side of which is scanned by the electron beam. Current flows between opposite faces of the target at the point struck by the beam at any instant, and is dependent on the conductivity of the target at that point, which depends in turn on the incident light via the camera lens. The equipment operates on the 625-line system.

The cable links consist of coaxial cables equipped at the receiving ends with video amplifiers and distortion correctors. Signals from the camera are transmitted along the links to the picture receivers without change of frequency. The standard Post Office coaxial cable contains air-spaced coaxial tubes of 0·375in outer diameter and having a nominal loss of 4 dB per mile at 1 Mc/s. To provide for warning of incipient faults and to reduce the ingress of water should the sheath become damaged, a gas pressure system is installed. The cable is filled with dry air at a pressure of 10 lb per square inch and pressure gauges maintain continuous supervision of its mechanical condition.

At the ends of each link, termination fittings provide for terminating separately each coaxial tube and the audio interstice pairs of the associated sound system, and for mounting the coaxial chokes which by limiting the magnitude of very low frequency longitudinal currents make possible the direct transmission of video frequencies on coaxial cable. The video amplifiers, which provide a gain of 20 dB, are of standard Post Office design identical with those used in the national television networks. Distortion caused by transmission of vision signals over the coaxial cable is corrected by the insertion of simple passive waveform corrector networks. These are aligned during installation by observing on a cathode ray oscilloscope the response of the link to a test signal from a waveform generator.

[Reply Card No. E7913]

Camera and monitor screen for inter-branch closed circuit television transmission of banking documents

# Industrial and Labour Notes

### Engineering Statistics

According to provisional figures collected by the Board of Trade, there was a substantial increase during September in the output of the engineering and electrical goods industries. It is stated that output was 11 per cent higher than in September, 1958, and, over the third quarter of this year, was 8 per cent higher than in the comparable period of 1958. Preliminary estimates for October indicate that production continued at about the same level. There was a seasonal fall during the third quarter in engineering and electrical goods exports, but in the second and third quarters the volume of exports was a little higher than in the comparable period of 1958. The volume of total orders in hand in September was much the same as in August, the index (January, 1958=100) standing at 88.

### Trade Prospects

In his annual statement as chairman of Tube Investments, Ltd., Sir Ivan Stedeford stresses the need for "development spending" on the part of industry. Few consequences of public policy in the past year or two, he says, were more disturbing than the need to level off or reduce industrial capital expenditure so soon after the first adequate effort for about twenty years had got well under way. It was disturbing, the statement adds, because the reading of the signs makes it clear that the actions of governments and the run of the tides of trade are taking industry into a climate in which more and sharper competition will be the prevailing weather, necessitating heavy and sustained capital expenditure on the most modern equipment.

Sir Ivan goes on to say that the Common Market in Europe presents Britain with a serious challenge which will grow stronger with the years. The initiation of the "Outer Seven" is to be welcomed, he comments, for its likely direct outcome and for its implication that some association with the Common Market may yet be worked out. But, Sir Ivan suggests, few can now feel very optimistic about the prospects of creating a free trade area over the whole of Western Europe, including this country. The chances are, he says, that in a few years this country will be faced across the Channel by an integrated system of great industrial resources, enjoying the economic benefits of large-scale production and attacking world markets with the strength of a huge protected home market behind it.

If, Sir Ivan asserts, Britain is to continue to be prosperous in a world of great industrial power blocs, or indeed of free trade, her industrial efficiency must be raised far beyond anything yet achieved or attempted. She should spend capital to the limit of her resources with particular emphasis on the latest material and work-saving equipment. In the next decade, Sir Ivan urges, such expenditure should be given as high a national priority as was once given to exports and housing. By its reintroduction of investment allowances, the Government has shown that it recognises the urgency of large-scale industrial development. But Sir Ivan expresses his belief that much more is needed. He calls for a crusade to make British industry, for its size, the best equipped in the world.

### Steel Development Programme

A further programme of steel plant development, involving an expenditure of £10,000,000, has been announced by The United Steel Companies, Ltd. The existing open hearth melting furnaces at the Rotherham plant of Steel, Peech and Tozer are to be replaced by six electric arc furnaces each of 110 tons capacity. When this project is completed, in about five years' time, the claim is that it will be the largest electric steel-making plant in the world, with an annual capacity of 1,350,000 ingot tons.

At present, there are twenty-one open hearth furnaces in the Steel, Peech and Tozer works—fourteen at Templeborough and seven in the Rotherham melting shop—producing 1,000,000 ingot tons a year. The existing Templeborough melting shop is to be adapted to house the new electric furnaces. The Rotherham melting shop is to be demolished. Initially, four swing-roof electric furnaces will be installed, and it is planned to have the first of them in commission by the beginning of 1963. In order to make a start on the plant, however, the first two open hearth furnaces at the Sheffield end of the Templeborough melting shop will close down in two years' time, to be followed by others as the scheme progresses. Arrangements have been made to maintain the present level of steel production during the change-over by fitting double oil burners to some of the furnaces and converting others to all-basic refractory linings.

### Oil Consumption

According to figures published by the Petroleum Information Bureau, oil consumption in the United Kingdom increased during the first nine months of the year by 17·4 per cent over the same period in 1958, to reach a total of 26,387,814 tons. This total exceeds that returned for the whole of the year 1957. Fuel deliveries amounted to 9,689,115 tons, an increase of 33·6 per cent, and gas/diesel oils totalled 2,247,129 tons. Motor spirit was in greater demand and rose by 7·2 per cent to 5,379,331 tons, while the consumption of Derv fuel at 1,672,403 tons represented an increase of 10·3 per cent.

### Trade with Scandinavia and Finland

Last May, there was a series of talks between the Federation of British Industries and commercial representatives of British Embassies in Denmark, Norway, Sweden and Finland. These talks were arranged solely to discuss the scope of the Scandinavian market for British goods. The proceedings have so far not been published in any form and the Federation of British Industries has therefore produced a pamphlet summarising the talks and setting out the main findings of those who participated in them.

The principal conclusion reached was that there had been "too little appreciation of the size and importance of these Nordic markets to British industry." The four countries taken together came second only to the U.S.A. as a customer for British goods. They were buying British goods at rates which varied from £10 per head in Finland to £20 a head in Norway, as compared with purchases of British goods in the U.S.A. at the rate of something like 32s. 6d. per head of the population. During the talks it was generally agreed that modern communications had made these markets easily accessible and that there was "plentiful goodwill towards the United Kingdom." They were markets, it was felt, which could be opened up without great difficulty by firms prepared to take the trouble to understand and cater for their needs.

One matter of special importance to the engineering industry is emphasised in the report. During the talks it was indicated that some British industries faced a dilemma in their efforts to sell engineering products in these markets where Continental standards were generally accepted. The fact that British Standards were demanded in other very large areas of the world, which provided an important share of Britain's export trade, created a problem for individual firms. The pamphlet says that each firm must, of course, make its own decision on how it can best fit these four markets into the general pattern of its export trade and, in particular, on how far it should make special adaptations in its standard products. But it seems likely, the pamphlet adds, that if greater flexibility can be shown in making superficial changes to meet customers' wishes, this might prove an important factor in dealing with the Scandinavian territories.

### Accident Prevention in Hand Rolling Mills

The accident prevention committee of the British Iron and Steel Federation has prepared a report dealing with the prevention of accidents in hand rolling mills. In producing this report, the committee realised that, since many hand mills are old and since by definition they involve manual handling not needed in a modern installation, it was necessary to discover how existing methods and machines could be made safer rather than to make sweeping recommendations for mechanisation or modernisation. Moreover, the committee recognised that the outstanding difference between works with high and low frequency accident rates did not depend on the kind of equipment but rather on the way in which it was used and the way the operatives were trained.

The majority of accidents in hand mills, the report says, arise from : insufficient care in selection and placing of operatives and in providing them with systematic training ; untidiness ; inadequate standard of maintenance of buildings, plant and equipment ; poor guarding of machines ; lack of suitable protective clothing and general unwillingness to wear or ensure the wearing of what is available. These, the committee emphasises, are all factors which make for inefficiency in operation and consequently result in accidents.

# Aluminium Conductors in South Africa

BY OUR SOUTH AFRICAN CORRESPONDENT

BECAUSE of its light weight, high conductivity, high strength, ability to resist atmospheric attack, and, above all, its low cost, aluminium has come into virtually exclusive use for conductors on new high-tension lines in South Africa. The two chief types now being used are

**Fig. 1—Linesman operating on 7 × 0·174in AAC in the Pietermaritzburg area**

the ACSR (Aluminium Conductor Steel Reinforced) and AAC (All-aluminium Conductor).

Even on rural electrification and low voltage schemes, the savings which can be effected are substantial.

The present price of copper is about £245 per long ton and that of aluminium £180. The density of aluminium being less than a third that of copper, and its conductivity 61 per cent compared with 97 per cent I.A.C.S. for hard drawn copper, the aluminium conductor will weigh only half as much as its copper equivalent for equal resistance. Half a ton of aluminium costing £90 will therefore do the work of a ton of copper costing £245. Viewed slightly differently, copper would have to fall to about £90 per ton to make the use of aluminium uneconomic.

When using AAC, the cost per mile of conductor results in a saving of nearly 50 per cent, and, if ACSR is used, the saving is reduced to about 40 per cent owing to the cost of the steel core wires. However, this saving can be increased considerably on h.t. lines by increasing span lengths, thus taking advantage of ACSR's strength.

To take a specific case (see Table below), it is possible to save 47 per cent on a 10-mile length of conductor by using aluminium rather than copper—current conduction being equal :

| | 19/16 S.W.G. hard drawn copper conductor | 7×0·134in stranded aluminium |
|---|---|---|
| Total weight of conductor ... | 12,700 lb | 6,180 lb |
| Cost per pound of conductor... | 2s. 6d. | 2s. 9d. |
| Total cost (10 miles) ... ... | £1,590 | £850 |
| Saving by using aluminium ... | 47 per cent | |

In addition to the saving of 47 per cent in first cost, there is obviously also a proportionate reduction in interest charges where overhead networks are financed from loans.

A further advantage gained by the use of aluminium is that its price is fixed by the producers and remains practically constant for long periods. The price of other non-ferrous metals traded on the London Metal Exchange is subject to comparatively violent day-by-day fluctuations, as may easily be verified by reference to the stability of the price of aluminium compared with the barometrical rise and fall in the price of copper over the past ten years.

Aluminium wire for overhead conductors is rolled and hard drawn from 99·5 per cent minimum purity aluminium and has a maximum volume resistivity of 2·8264 microhm-centimetre, at 20 deg. Cent. (68 deg. Fah.). Conductors stranded from pure metal are not quite as strong as the equivalent copper, but as they have half the weight, they may be erected to the same sags as copper on l.v. networks. By incorporating one or more high-tensile galvanised steel wires in an aluminium conductor it is possible to obtain conductors much stronger and lighter than copper. The increased strength varies from 40 per cent with standard 6 aluminium/1 steel ACSR, to five or six times with special strandings. The wide range of high-strength conductors means that lines can be designed for maximum efficiency in any type of country.

To the linesman, the relatively light weight of AAC and ACSR is probably their most obvious and appreciated advantage, as this contributes materially to easier and faster handling, with large reductions in transport costs and substantial economies during erection. A large

**Fig. 4—Aluminium conductor under electrical test in the laboratories of Aberdare Cables, Africa, Ltd., of Port Elizabeth**

amount of ACSR (6/1×0·093in and 6/1 ×0·144in) and AAC (7×0·086in to 7×0·174in) has been used on high and low-tension lines in Pietermaritzburg. The linesman in Fig. 1, shown operating in that area, is working with 7×0·174in AAC. It has been established that a minimum life span of fifty years can confidently be expected in rural areas in this region, and that unprotected conductors in more heavily polluted and marine atmospheres will last twenty-five to thirty years.

Stranded conductor is produced by Aberdare Cables, Africa, Ltd., of Port Elizabeth, and Fig. 4 shows aluminium conductor under test at its laboratories. The Union Steel Corporation (of South Africa), Ltd., of Vereeniging, is also a producer, and Fig. 2 shows a close-up photograph of a fifty-four bobbin aluminium cable strander in operation at its works.

In a slightly different field, considerable savings can also be made by using aluminium busbar. A typical busbar installation is shown in

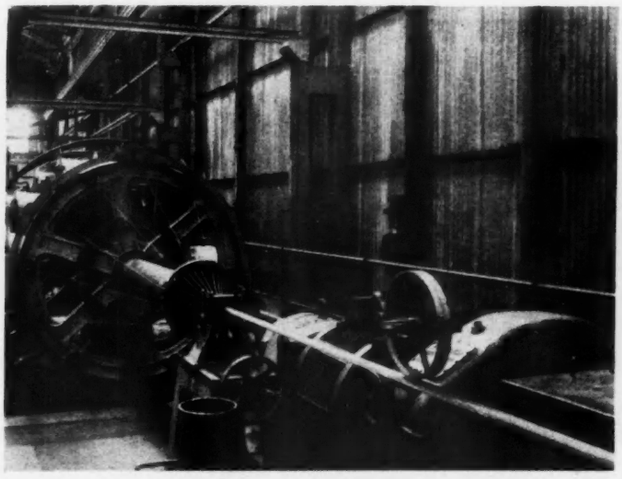


**Fig. 2—Close-up of a 54-bobbin aluminium cable strander at the Vereeniging factory of Union Steel Corporation (of South Africa), Ltd.**

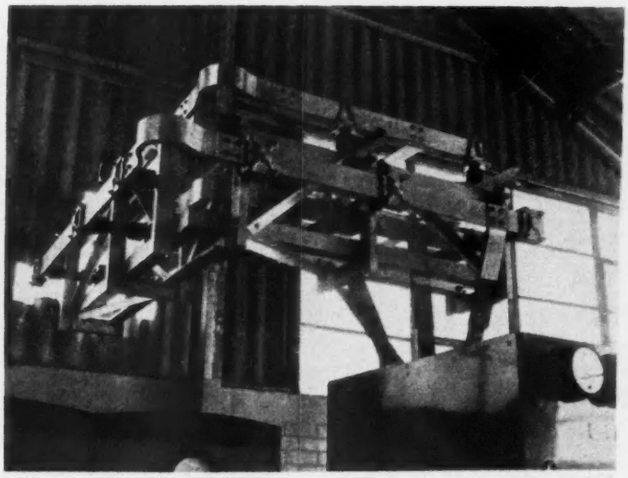


**Fig. 3—A typical aluminium busbar installation**

Fig. 3. For equivalent conductivity, an aluminium busbar is only about half the weight of a copper one and substantial savings in the cost of supports can be made. The low cost, light weight, good conductivity, ease of fabrication and erection, excellent weathering properties and resistance to chemical action of aluminium installations, together with the fact that electrical joints of high efficiency can be made by adopting any of the methods in current use of joining metals—are the factors which have influenced its use in this field in South Africa.

As an example of a development along these lines in South Africa the following case is worthy of record.

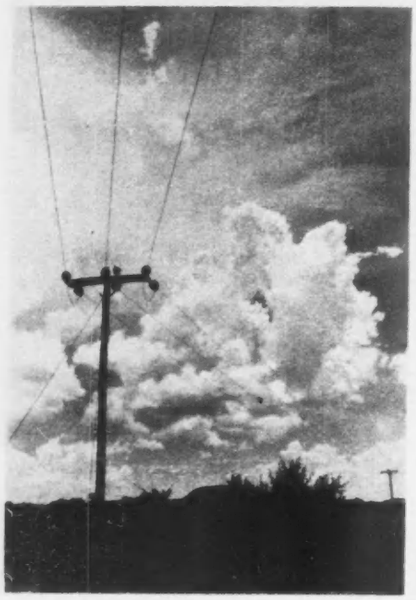


Fig. 5—400ft span in 22kV line from Warmbad to Nylstroom

Six years ago, the municipality of Warmbad, in the Transvaal, had a small diesel power station of 250kW capacity running at a loss of £3000 per annum. On the advice of its town electrical engineer it was decided to purchase and erect a steam plant comprising two 1000kW turbo-alternators and three 9000 lb per hour steam boilers at a total cost of £80,000. As this represented eight times more power than Warmbad had ever been able to use and additional outlets for this surplus power had to be found, attention was directed to meeting the large potential market in the surrounding rural and farming areas. To this end it was decided to erect transmission lines consisting of creosoted wood poles with pin insulators on wooden cross arms carrying ACSR conductors.

The first rural area to be supplied was Pienaars River, 20 miles south of Warmbad, the line comprising 6/1×0·110in ACSR operating at 22kV. Tnis was the beginning of an unbelievable expansion programme. To-day, Warmbad supplies Nylstroom, Union Tin Mines, Ltd., the Buffalo Fluorspar Mine, Naboomspruit, Crecy, Roedtan and a large part of the Springbok Flats by means of ACSR transmission lines at voltages up to 66kV.

Fig. 5 shows a view of a 400ft span on Warmbad's 22kV ACSR line to Nylstroom. These long spans are a feature of this line. There is a 66kV line, with 6/1×0·132in ACSR conductor, to the Union Tin Mines—a distance of 60 miles.

Development along these lines is continuing and at the moment another step-down transformer from 66kV to 22kV is being installed about 14 miles from Warmbad. A further 38 route-miles of ACSR line will run from this point to supply Settlers, Tuinplaas and Nutfield.

Altogether some 750 conductor miles of ACSR have been erected in Warmbad's 60 miles radius licensed area of supply at a cost of £164,000, and the Electricity Department, which ran at an annual loss of £3000 only six years ago, with a 250kW load, now generates 3700kW and shows an annual profit of about £11,000. It is estimated by the town electrical engineer that over £164,000 was saved by using aluminium conductor. But for this it would have been impossible to effect this profitable expansion.

## Durban Bluff Drainage Tunnel

Two parallel hills, in the Durban area, running along the coast line, enclose between them a swampy area of some 500 acres, long known to Durban residents as "The Bluff." Since both sides of this area are rapidly becoming built-up and expansion is now hampered by the damp nature of the remaining available ground, the Durban Corporation decided to have investigated the problem of draining this otherwise waste land.

The consultants were Messrs. Campbell, Bernstein and Irving, and Roberts Construction Company was awarded the contract to carry a scheme through. Briefly, this was to drive a drainage tunnel through the seaward ridge so that, on a gradient of 1·225, the swamp would be discharged into the sea. The level of the swamp is 26ft above sea level and the tunnel was designed with an invert, 10ft above sea level at the swamp end, while the outlet end was to lie 3ft above sea level.

The work was begun in the middle of June, 1958, and after due preparation three shifts were soon in operation, progress varying from 14ft to 38ft per week. The length of the tunnel is 1500ft and during the progress of its construction an inlet caisson was built on the swamp side of the tunnel in preparation for the break-through of the shield, which finally took place on March 25, 1959.

The method of tunnelling was by pressure-driven shield, which was cylindrical in shape and consisted of three sections totalling 9ft in length. These sections were the front hood and cutting edge, which cut into the soil and afforded a core for the men working at the face, the centre section, and the rear skirt, which housed the six hydraulic rams for driving the shield. Fig. 1 shows the operation of sealing the shield being

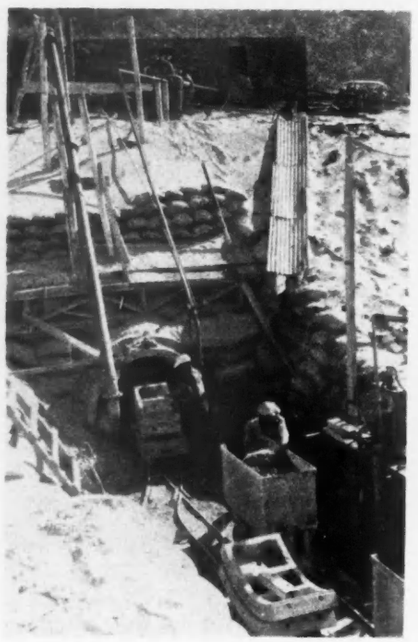


Fig. 3—Entrance to tunnel

carried out. The "body" of the tunnel, a portion of which is shown in Fig. 2, consisted of precast concrete segments which were bolted together to form 20in wide rings. Each complete ring comprised five segments which were used to construct rings with an external diameter of 6ft 3in. Fig. 3 shows the entrance to the tunnel.

The final operation to be carried out is the plugging of the leaks between the ring joints, the internal lining of the tunnel with a 4in layer of concrete, and the completion of a section of 130ft at the outlet to bring it to the edge of the beach.

Fig. 1—Sealing of the shield

Fig. 2—Bluff tunnel under construction

# High Power Laboratory at Ludvika

*Last year a new high power laboratory was inaugurated at the Ludvika works of A.S.E.A., which replaces an older installation dating from* 1933. *The laboratory, which became fully operational in the course of this summer, possesses short-circuit generators with a nominal total capacity of* 3500*MVA. Much attention has been paid in the layout to achieve a smooth flow of the items to be tested, which are assembled and mechanically tested before being transferred to the electrical test cells. The latter are remotely operated from a single control room where all test measurements can be taken and recorded.*

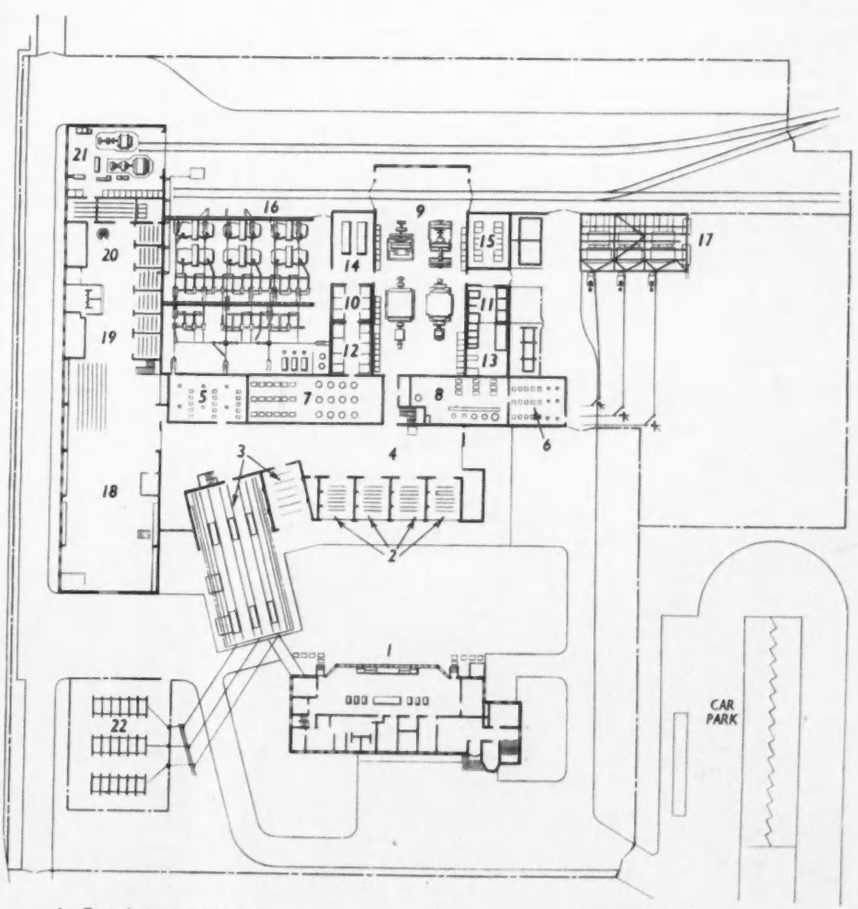
DURING the last year the new high power laboratory at the A.S.E.A. works at Ludvika has come into full operation. It supersedes the high power section of an earlier combined high power-high voltage laboratory which had been functioning since 1933. Among recent major developments with which Ludvika has been associated may be mentioned the world's first 380kV transmission which was installed in Sweden in 1952, and the Gotland d.c. submarine transmission for which the factory supplied transformers, circuit breakers and other equipment, as well as contributing important research. The continued tendency towards higher voltages and powers, as well as the expansion of production, made it necessary to provide improved facilities for development as well as production testing.

The new laboratory, which may be seen in our title illustration, occupies a site of 2 hectares on the shore of Lake Väsman. The illustration shows the office block, which also houses the main control room, on the left while behind it are visible some of the test cells and part of the machine hall. The layout is shown in fuller detail in Fig. 1, which very clearly brings out the underlying principle of strictly separating the workshop, testing, machine and control areas, which, together with the remote control of all the tests from a single point, leads to smooth and rapid operation. Particularly time-saving is the ability to set up a test outside the test cells, which may be a matter of hours or even days, later transporting the complete set-up into the cell when this becomes available, for a test which itself takes only a fraction of a second.

Item (1) is the office and control building mentioned which also houses a semi-conductor rectifier laboratory. The large control room faces towards the test cells which are in full view from the windows. Four identical smaller cubicles (2) are equipped for tests at up to 70kV, while two large cubicles (3) can be used at the maximum voltage. These form part of the machine and workshop block. Immediately behind the test cells is an assembly shop (4) from which access is obtained to the cells through doors which are electrically locked during testing. Capacitators for setting the rate of rise of the restriking voltage are housed in rooms (5) and (6), while current-limiting reactors and resistors for setting the power factor are in rooms (7) and (8). The symmetry of these items, which extends to the machine hall (9) and other sections of the installation, is due to the fact that there are two large short-circuit generators which it is desired to operate independently as well as in combination.

The installations associated with the machine hall comprise two sets of switchgear with back-up circuit breakers (10) and (11), switchgear with high-speed making switches (12) and (13), the air compressor plant (14), distribution switchgear (15) and the outdoor high power transformers (16) and (17).

Situated in the wing on the left of the building is another workshop and assembly bay (18), a view of which is shown in Fig. 2. From it are reached the control room and test sites (19) for carrying out the preliminary mechanical testing of circuit breakers, and the control room and test sites (20) for certain high current tests. The machines supplying current for these tests are housed at the end of the building in a separate hall (21). An outdoor battery of capacitators (22) can also be seen on the left in the title illustration, and is used for capacitative breaking tests. The total floor area of the buildings is about 6000 square metres.




1.—Control room and offices.
2 and 3.—Test sites.
4.—Assembly workshop and passage-way for test objects.
5 and 6.—Capacitators.
7 and 8.—Reactors and resistors.
9.—Machine hall for high power generators.
10 and 11.—Switchgear with back-up circuit breaker.
12 and 13.—Switchgear with high-speed making switch.
14.—Compressor plant.
15.—Distribution switchgear.
16 and 17.—High power transformers.
18.—Assembly workshop.
19.—Control room and test sites for mechanical testing of circuit breakers.
20.—Control room and test sites of the high-current laboratory.
21.—Machine hall of the high-current laboratory.
22.—Capacitator battery.

**Fig. 1—Layout of high power laboratory**

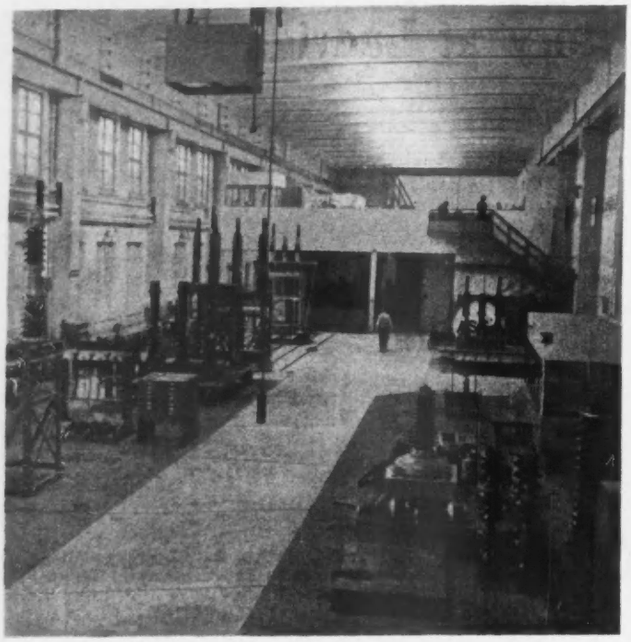
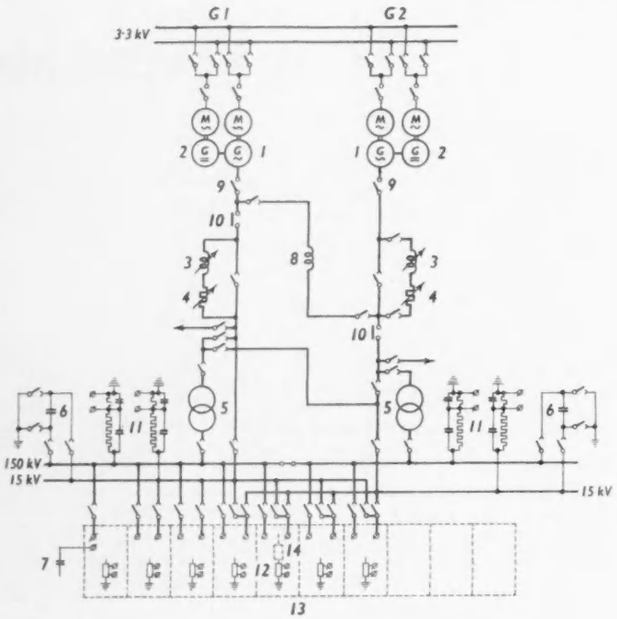


Fig. 2—Assembly workshop for erection of switchgear prior to testing




1.—High power generators.
2.—Exciters.
3.—Current-limiting reactors.
4.—Resistors for setting the power factor.
5.—High power transformers.
6.—Capacitators for setting the rate-of-rise of the restriking voltage.
7.—Capacitator battery for capacitative breaking tests.
8.—Synchronising reactor.
9.—Back-up circuit breakers.
10.—High-speed making switch.
11.—Voltage dividers for voltage measurement.
12.—Shunts for current measurement.
13.—Test sites.
14.—Circuit breaker under test.

Fig. 3—Circuit diagram

### Machines and Equipment

The electrical circuits are diagrammatically represented in Fig. 3. The heart of the installation are the two high power generators (1), a new one with a nominal short circuit rating of 2500MVA, and one taken over from the old laboratory with a rating of 1000MVA, together with their exciters (2). In Fig. 4 the new machine is on the right, the smaller and older one on the left, with the two exciter sets in the foreground. It is intended later on to replace the 1000MVA machine by another of 2500MVA. The sets are run up to speed using the local 3·3kV mains supply.

*No. 1 Generator Set.*—The No. 1 generator is a machine with a continuous rating of 150MVA at a speed of 1500 r.p.m., generating at 7·5/13/15kV. The short circuit symmetrical breaking power after 0·2 second is 2250MVA, the short circuit power with symmetrical connection, 2500MVA, while at the terminals, about 3000MVA can be generated. The overall weight amounts to 233 tonnes, of which the rotor represents 90 tonnes, with a moment of inertia of 120 tonnes × m². The machine is mounted on springs and has a completely closed cooling system. There are no damping windings. The driving motor has a rating of 3000kW.

The exciter (Fig. 5), which can also be used separately for d.c. tests, is nominally rated at 6000kW and has a speed of 428 r.p.m. and a service voltage of 1050V. During tests the exciter has to supply 27kA for about 0·2 second or about 28MW. Since this would put an excessive momentary load on the grid, the energy is derived from a heavy flywheel mounted on the same shaft.

*No. 2 Generator Set.*—The second high power set is based on exactly similar principles as the preceding set but is rather smaller. Thus, the generator has a nominal continuous rating of 80MVA. Operating at 1500 r.p.m., like the other set with which it can be synchronised, it generates at 3·75/6·5/7·5/13kV and has a short circuit rating, both for symmetrical connection and for symmetrical breaking after 0·2 second, of 1000MVA, while the short circuit power at the terminals is of the order of 1300MVA. The weight is 168 tonnes, of which the rotor of 80 tonnes × m² accounts for 66 tonnes. The driving motor is rated at 1000kW.

The 3000kW exciter operates at 428 r.p.m., like the other, but with a service voltage of 1000V, and can give 10kA during 0·2 second. It also has a flywheel and can be used on its own as a source of direct current.

*Switchgear.*—Between the high power generators and the busbars are back-up circuit breakers with a breaking capacity of 65kA per pole at 13kV. Each of the two breakers is a

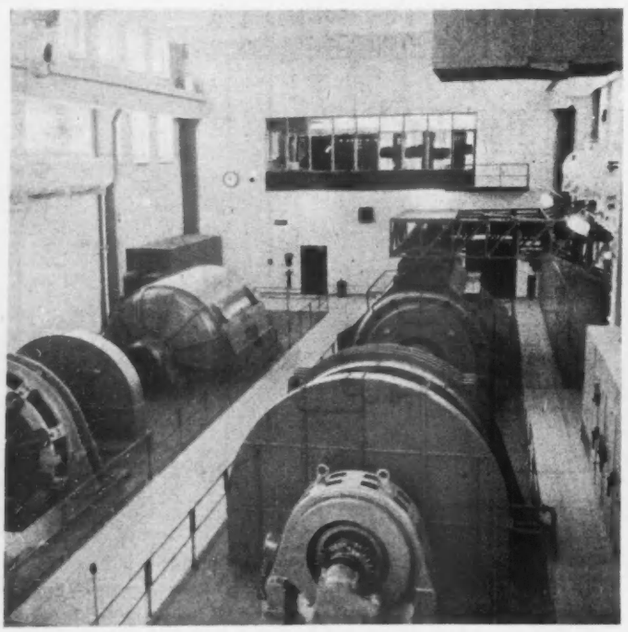


Fig. 4—Main machine hall with 3000MVA short-circuit generator on right, 1300MVA generator on left. In the foreground are the two exciters. The machine control room is at the back

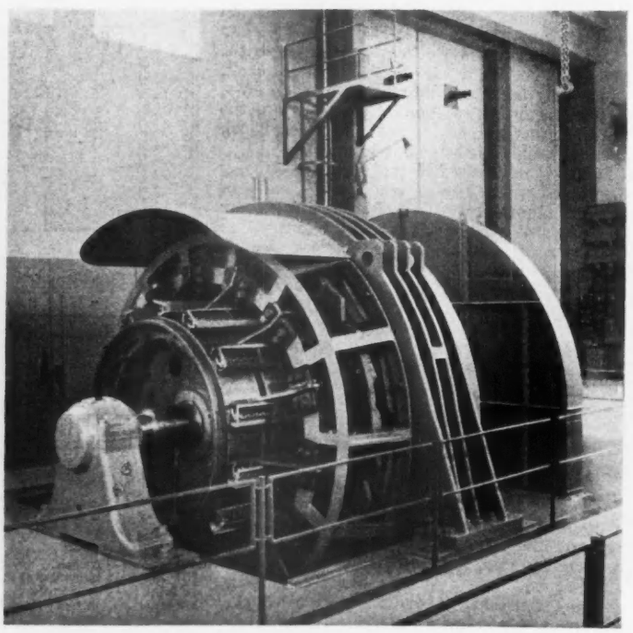


Fig. 5—Exciter for 3000MVA short-circuit generator. The exciter has a continuous rating of 6MW, but is capable of giving 27kA at 1050V during 0·2 second

six-pole air-blast unit requiring an air supply at 15 atmospheres ; they are connected in series with each generator phase winding, i.e. with two poles per phase.

The making switches are three-pole air-blast circuit breakers, suitable for peak values of the closing current of 300kA at 15kV. The air supply is again at 15 atmospheres. Making accuracy is ±5 electrical deg.

For the 15kV busbars, remote motor-controlled isolators are employed suitable for surges of 400kA and short-time currents of 130kA lasting two seconds.

High tension isolators are similarly remote-controlled. Designed for a nominal 150kV and a peak surge current of 300kA, they can carry a two-seconds current of 100kA.

*Reactors.*—Four reactors are provided for each phase of the No. 1 set, having a reactance of 0·03 ohm per unit at 50 c/s and giving a setting range at this frequency of 0·0075 to 0·12 ohm per phase. The service voltage is 15kV.

No. 2 set has associated with it five 13kV reactors of varying size, their combinations covering a range of from 0·033 to 3·9 ohms.

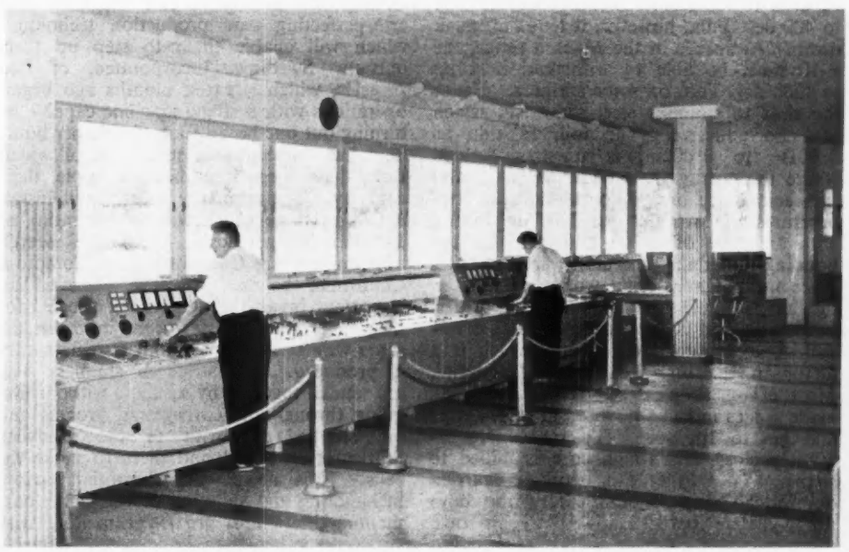


**Fig. 6—Control room with main control desk. The desk permits the remote control of the test cells and the carrying out of tests using the two short-circuit generators installed either separately or in combination**

*Resistors.*—These number six per phase for the No. 1 generator set, and three per phase for No. 2 set, both kinds of resistors being designed for operation at 15kV. The six for No. 1 set have a resistance of 0·04 ohm each and cover the range 0·0067–0·24 ohm ; the other three have resistances of 0·04, 2×0·02, and 2×0·02 ohms, and cover a range 0·0045 to 0·12 ohm.

*Capacitators.*—For setting the rate of rise of the restriking voltage, the number of capacitators provided per phase of No. 1 generator set is thirty-eight, being made up of thirty-five "CKTE5" and three "CKY" capacitators, and covering a range of 0·004–130μF per phase. For No. 2 generator set there are twenty-four capacitators per phase (twenty "CKTE5s" and four "CKYs") giving 0·016 to 130μF per phase. The total nominal ratings of the two groups are respectively 3150kVAr and 1800kVAr, at maximum service voltages of 150kV and 132kV respectively.

Capacitative breaking tests can be carried out by means of a third group arranged out-of-doors (item 22 in Fig. 1), which contains three sections of 288 "CTD2" capacitators, one for each phase, covering 2·5–360μF per phase—an extension to 2900μF being provided for—with a maximum service voltage of 165kV and a total nominal rating of 21,600kVAr.

*Transformers.*—No. 1 generator set has associated with it six single-phase step-up transformers each having three high-voltage windings with a winding voltage of $24/\sqrt{3}$kV. The maximum three-phase voltage obtainable is 144kV, the maximum single-phase voltage with earthed neutral is 250kV. Total short circuit power rating is 9000MVA. Each of the six units weighs 154 tonnes.

The second generator set also has six single-phase transformers, with a combined short circuit rating of 3000MVA. Three of these have four high-voltage windings of $22/\sqrt{3}$kV, the rest have four windings of $33/\sqrt{3}$kV. These designs differ somewhat in size, weighing respectively 85 and 76 tonnes. The maximum obtainable three-phase voltage is 220kV, the largest single-phase voltage with earthed neutral is 380kV.

*Subsidiary High Current Supply.*—In order not to have to use the large machines for certain minor tests, two smaller sets of a combined rating of 80MVA have been installed (item 21 in Fig. 1). Excitation for these machines is provided from grid-controlled rectifiers operated by magnetic amplifiers.

*Measuring Equipment.*—For voltage measurements, high resistance dividers with capacitative compensation are available, suitable for a maximum measuring current of about 1A.

Low resistance shunts of coaxial design are installed for measuring currents. These shunts give rise to voltage drops of up to about 10V.

Pressure measurements may be carried out with capacitative and piezo-electric transducers in combination with appropriate bridges and amplifiers.

Movements are measured and/or recorded with the help of continuous and step transmitters, torsion wire transmitters, vibration meters and high-speed cameras of the continuously moving film type or drum type. Schlieren equipment is available for investigating air flow.

*Recording Instruments.*—These comprise bifilar oscillographs, cathode-ray oscillographs and mechanical recorders.

### Testing and Control

Three-phase breaking tests can at present be carried out up to the following limits : 3250MVA at 13kV, 2200MVA at 125kV, 2000MVA at 144kV, and 750MVA at 220kV. Single-phase tests can be conducted up to 1200MVA with voltages up to 250kV, and up to 450MVA at a maximum voltage of 380kV.

As Fig. 3 shows, the output from the two short-circuit generators can be directed into either of the two 15kV busbars or, after stepping-up by the transformers, the two 150kV busbars. The latter can be linked together. In four of the test cells, both 15kV busbars are available, while the remaining three test sites, as already mentioned, are intended mainly for tests at voltages exceeding 70kV, so that for them one 15kV busbar was considered sufficient. Space has been reserved for the later addition of further test cells if this should become necessary.

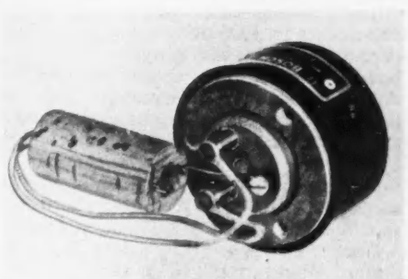
The main control room has been allotted a generous amount of floor space, as this is the centre from which all actual testing is carried out and where the results are recorded. Besides the large control desk, shown in Fig. 6, a variety of measuring and recording equipment is installed.

The control desk comprises two symmetrical halves, one for each of the two main generator sets. The two sections are normally independent but may be combined when the sets are to be run in synchronism. Switch positions are shown on the diagrammatic panel. For the timing of switch positions during tests, each desk section has a mechanical switching device comprising a spindle which can be rotated in synchronism with the generators. On it are situated a number of discs with their circumference divided into electrical degrees and carrying adjustable stops which actuate corresponding stationary switches.

The system is specially adapted for testing with "flying excitation." The high short circuit current causes a drop in the generator voltage which must be compensated if a high proportion of the energy stored in the generator is to become available in the test. Compensation is usually achieved by means of a suitable amount of initial over-excitation. By contrast, with the method of "flying excitation," the test is initiated while the excitation is rising, the instant of starting being accurately chosen so that the subsequent rise in excitation just compensates for the voltage drop.

## Oil Level Switch

A float-operated switch for operating a warning circuit has been produced by Robert Bosch G.m.b.H., Stuttgart. The design, which is shown in our accompanying illustration, is intended to control the oil level in central lubrication installations. An impregnated cork float contains a mercury switch, which is actuated when the cork tilts owing to a fall in the oil level. The closing of the switch in turn operates a warning light or acoustic signal.



**Oil level switch with mercury switch embedded in impregnated cork float. By means of the flange, the switch can be mounted on the side of the oil tank**

## Ceramic Insulation

The Central Research Institute for Building Materials, Budapest, recently announced the production of a new lightweight insulation stated to be suitable for temperatures up to 1350 deg. Cent. The material is said to be based on the mineral perlite of which large deposits exist in Hungary and which up to now has been used in conjunction with plaster for heat and sound insulation. The new material, which has been named "Riopirite," is a foamed ceramic form of this mineral which at present is manufactured in two grades, for insulation at up to 900 deg. Cent., and for up to 1350 deg. Cent. Its density is quoted as being less than that of similar known lightweight insulations, making the material more economic in use.

# The American Scene

BY OUR AMERICAN EDITOR

## Boom in Honeycomb

The fabricators of honeycomb core and sandwich, one of America's youngest industries, are currently enjoying a greatly increasing demand for their products. This new construction material of exceptionally high strength-to-weight ratio can be made of wood, paper, cotton, fibreglass, aluminium or a number of other substances, but the one attracting particular attention at the moment is stainless steel foil. Thin strips of stainless steel are corrugated and then welded together in a honeycomb pattern—whence the name—to form a core resembling an automobile radiator. This is placed between two sheets of slightly thicker stainless steel, to which it is attached by brazing to make the sandwich. Since it is 90 per cent air, the resulting material is extremely light, yet sturdy enough to resist the high temperatures and strains encountered by an aircraft flying at 2000 miles per hour. As far as can be foreseen at the moment, honeycomb is destined to be the fabric from which to-morrow's supersonic aircraft, intercontinental ballistic missiles and space vehicles will be constructed. Although it has been used in limited quantities in other aircraft, its first large-scale application will be as structural material and "skin" for the B-70 "Valkyrie" which will take about 20,000 square feet of honeycomb sandwich. When used in aircraft, the material must be virtually custom-made and it costs from 400 dollars to 1000 dollars per square foot, depending upon the gauge. Thus, each bomber will constitute at least an 8,000,000 dollar market for honeycomb. As new production techniques are developed, prices are expected to drop sharply; nevertheless, by the end of 1963, when the output of B-70s is scheduled to reach its peak, the annual sales of honeycomb for airframes should climb at least to 172 million dollars.

Honeycomb was first used in the U.K. during World War II as an "ersatz" material to replace scarce metals in airframe construction. Panels of balsa-wood core faced with birch were used in the de Havilland "Mosquito" bomber. Towards the end of the war, Chance Vought, in America, came up with a material called "Metalite," consisting of balsa-wood between metal facings, which was used in the F5U, F6U, F7U and F8U series of naval aircraft. As aircraft have grown larger and heavier, attaining higher and higher speeds, honeycomb has come increasingly into use, as designers require improved strength-to-weight ratios. A rule of thumb in aircraft construction states that every ounce saved in the building of the basic airframe means 10 oz saved in supporting members and fuel at take-off time. Before the advent of supersonic aeroplanes, the best method of cutting down the weight of aircraft without sacrificing strength was through the use of honeycomb sandwich made of aluminium or, to a lesser extent, fibreglass. Core of these materials is made with film or foil ranging from 0·0007in to 0·006in in thickness. The narrow strips are spot-bonded with resin and then pulled out, in accordeon fashion, to form the honeycomb pattern. Facings ranging in thickness from 0·005in to 0·06in are glued to the surface with adhesive. Such constructions are used extensively in the B-52 jet bomber, the B-58 "Hustler," the F-102 interceptor and the KC-135 jet tanker, as well as in the new commercial jets. The Convair 880, for example, uses about 1200 square feet of honeycomb in structural applications, together with flooring of aluminium sandwich and interior partitions made of plastic-impregnated paper core between aluminium and fibreglass facings. Adhesive-bonded honeycomb also has been used extensively in missiles and their launching platforms. The body of the first U.S. moon-probe vehicle, "Pioneer I," was made of fibreglass honeycomb sandwich.

When adhesive-bonded honeycomb is exposed to temperatures exceeding 300 deg. to 400 deg. Fah., however, it tends to break down. At speeds in the Mach 3 range, the B-70 must be able to withstand heat up to 1200 deg. Fah. on some surfaces. Hence the shift to stainless steel sandwich, which uses no adhesive. The foil, as thin as 0·001in to 0·002in, is resistance-welded where the corrugations come together, and the facings are brazed to the core at temperatures of 1800 deg. to 2200 deg. Fah., with an alloy of nickel and silver as the bonding material. The entire process takes place in spotlessly clean works where even the air is filtered to keep out impurities. Ultrasonic and X-ray testing results, nevertheless, in a rate of rejections, which is a factor in the high cost of the material. Most of the stainless steel core now being made comes in cell sizes of $\frac{3}{16}$in to $\frac{1}{4}$in wide and $\frac{1}{4}$in to 1in deep. Tolerances are extremely close, and rough core is milled to shape. As a rule, this work is carried out by the sandwich fabricator, who buys rough-cut core and mills it to his own specifications. Core is sold by the board foot, and the going price is currently 25 dollars to 35 dollars per foot. As output increases and new production techniques are developed, however, it is anticipated that these prices will be reduced. A survey carried out for the U.S. Navy by the Stanford Research Institute shows that the industry's present capacity is 588,000 board feet of core per year. To fulfil the needs of the B-70 production, this will have to rise to 752,000 board feet by the end of 1960, and 860,000 in the final quarter of 1961. In 1962, facilities will need to be expanded to permit an output of 2,400,000 board feet and by the end of 1963, when the bomber programme reaches its peak, 3,400,000 board feet will be required. The Institute estimates that this expansion will permit core prices to be reduced to about 10 dollars per board foot, while the price of sandwich will come down to about 75 dollars per square foot.

To be sure, there is always the possibility that the B-70 programme may be cut back or eliminated if Russia agrees to real disarmament, or if the Pentagon decides to rely on missiles at the expense of manned aircraft. Some honeycomb makers, noting the cancellation of certain F-108 contracts and the "freezing" of the B-58 programme at its present target of some ninety aircraft, have been hesitant to expand their capacity in view of these possibilities. Even if the B-70 contracts eventually should be cancelled, demand for stainless steel honeycomb probably will continue to rise. Large quantities will be needed for the more advanced missiles and for the space vehicles and platforms to be used for lunar and interplanetary exploration. Civilian markets also are expected to develop as the whole concept of flight moves into the supersonic sphere. It has been claimed that the commercial airlines will skip the Mach 2 stage of development and go directly to Mach 3 to Mach 5 airliners, which will require stainless steel honeycomb construction. Such aircraft already are in the planning stage at North American, Convair and Lockheed, and they are likely to be flying by 1970. Thus, a number of honeycomb makers already are adding to their capacity and are perfecting new production techniques which will enable them to step up their output. Swedlow, Incorporated, of Los Angeles, which eighteen months ago began operations with a single machine capable of turning out one board foot of core per hour, now has thirteen such machines, of which three have been modified to triple their capacity. The company shortly will install a new machine which will have a rating of 14 board feet per hour. The Tool Research and Engineering Corporation, of Compton, California, believes to have achieved an important break-through with a process for making expendable steel core in much the same way as aluminium and fibreglass core is produced. The strips of stainless steel are welded together by machine without first going through the corrugating process and are shipped forthwith to the sandwich fabricators, who expand them to make the cells. This results in substantial savings in handling and shipping costs. Some core manufacturers also are experimenting with structures other than honeycomb. One is a waffle-type core, and another is a corrugated core similar to that used for cardboard cartons. Since these would use large sheets of steel foil, rather than narrow strips, and would not have to be welded, the core could be made far more cheaply than honeycomb.

The sandwich fabricators, meanwhile, are working on new brazing methods. At the present time some use molten salt as the heating agent, while others use quartz lamp or electric blanket brazing. Temco Aircraft has developed a process called zone brazing, in which heat is applied in a gas-fired furnace as the sandwich panel moves through it. Solar Aircraft has a process in which the furnace moves instead of the panel. It crawls at a speed of several inches per minute on rails alongside the workpiece, brazing at temperatures up to 2000 deg. Fah. This method makes possible the treatment of long panels with a smaller and less expensive furnace than otherwise would be necessary; the company begins its first factory production this month on a 16ft honeycomb wing spar. A long-range aim of the industry is to develop a method of resistance welding the facing to the core. The J. J. Foster Manufacturing Company, of Costa Mesa, California, and Sciaky Brothers, of Chicago, have developed prototype machines for this purpose. A recent study by the Aerospace Industries Association predicted that resistance welding will be in general use for sandwich fabrication in

five to ten years. It will entail a considerable reduction in prices for honeycomb sandwich, and, in any case, it will be necessary before aircraft can move into the Mach 4 speed range. By that time, stainless steel honeycomb is likely to be replaced for aircraft and missile construction by newer and more " exotic " metals, such as titanium, tantalum, molybdenum, vanadium, beryllium, irridium and rhodium, some of which can withstand temperatures up to 2000 deg. Fah.

Meanwhile, the prices of stainless steel honeycomb are expected to drop sufficiently to enable it to find important commercial markets. Applications are anticipated in nuclear reactors, heat exchangers, storage tanks, machine housings, truck bodies, hydrofoils and microwave aerials. Nor have all the possibilities of aluminium and other types of honeycomb been exhausted, by any means. As long as aircraft up to the range of Mach 2 continue to be built, considerable quantities will be needed, and even in the Mach 3 airframes they will be used for non-structural assemblies. Civilian markets also are opening up for aluminium honeycomb. The long canopy over the new ticket office at Pennsylvania Station in New York is made of this material. The Convair engineering division headquarters in San Diego recently was given an aluminium honeycomb facade, and the main building of the San Francisco airport has a facade of aluminium honeycomb core faced with porcelainised steel. There already is promotion for the use of adhesive-bonded honeycomb in packaging and for the construction of curtain walls, movable partitions and doors. Thus, in the next decade honeycomb construction will find important uses on the ground, and it will be essential if man is to fulfil his dreams of cruising around the globe at three or four times the speed of sound, send bulky missiles to the moon and ultimately explore outer space.

## International School of Nuclear Science and Engineering

THE U.S. Atomic Energy Commission has announced that the curriculum at the International School of Nuclear Science and Engineering will be raised to a higher professional level and the programme broadened to meet the growing needs for highly advanced and specialised training of scientists and engineers in the nuclear field. The name of the school, situated at the Commission's Argonne National Laboratory at Lemont, Illinois, will be changed to the International Institute of Nuclear Science and Engineering. All changes will become effective on January 1, 1960. The Institute's curriculum will be at the post-graduate level. The facilities of the International School for training in the design, instrumentation and use of nuclear research and power reactors will be expanded to meet the requirements of the Institute. Both foreign and U.S. students will be admitted for study under the new programme. As is the case with the present international school, all foreign applicants must have the sponsorship of their respective governments and their employers. U.S. citizens applying for admission must be sponsored by the Commission, its contractors, or by other appropriate governmental, educational, industrial or non-profit organisations. Appointments to the Institute will be on two levels. The first, the " participant " level, will require the equivalent of a master's degree of science from an American university and a background in fundamental nuclear studies. Participants may be selected for one or two sixteen-week semesters. The tuition for scientists and engineers at this level will be 1000 dollars per semester. The second, or " affiliate," level will be more advanced, requiring the equivalent of a Doctor of Philosophy degree from an American university. Affiliates will not be accepted by the Institute for less than two semesters and their abilities must be such as to enable them to contribute significantly to the overall Argonne Laboratory research programme in developing peaceful applications of atomic energy. No tuition will be charged students at affiliate level.

The International School has been operated since 1955 by the Commission, in co-operation with the Department of State, as part of President Eisenhower's Atoms-for-Peace programme. The International Co-operation Administration and the International Educational Exchange Service of the Department of State have provided financial support for many of the foreign students. The students' training included seventeen weeks of study either at North Carolina State College or Pennsylvania State University prior to arriving at Argonne. In the four years that the International School has been operating it has trained 478 scientists and engineers, 376 from foreign countries and 102 from the United States. Forty-four students are now attending the Argonne portion of the ninth session of the International School, which commenced on August 17. Because of the higher academic requirements in the future the students must qualify for direct entry at Argonne without taking the seventeen weeks of preliminary training formerly given at North Carolina State College and Pennsylvania State University, which was part of the International School programme.

The new Institute will provide advanced training not available at the present time in U.S. colleges and universities. The Institute in 1960 will offer programmes in the five areas as follows :

1. *The Science and Technology of Reactor Systems.*—This course, resembling one now taught in the International School, deals with present-day applications of nuclear reactors. It will be offered on a one or two semester basis to those on the participant level, with individual studies also provided for affiliates.

2. *Advanced Training for Engineering Research and Development.*—This course will include some of the material now offered in the International School, but it will emphasise future development of reactors for power and research. It will be offered to those on the participant level for either one or two semesters, and will be available to affiliates for individual study.

3. *Advanced Training and Research in the Physical Sciences.*—This area of study will consist of on-the-job association with Argonne scientists, mainly with members of the Laboratory's Chemistry and Physics Divisions. There will be supplementary special lectures and seminars will be offered. The course will be available only to those on the affiliate level.

4. *Advanced Training and Research in the Life Sciences.*—This study area is being offered for the first time as part of Argonne's international training and research programme. It will consist of on-the-job association with Argonne scientists, mainly with members of the Biology and Radiological Physics Divisions. Supplementary special lectures and seminars will be offered. The course will be available only to those on the affiliate level.

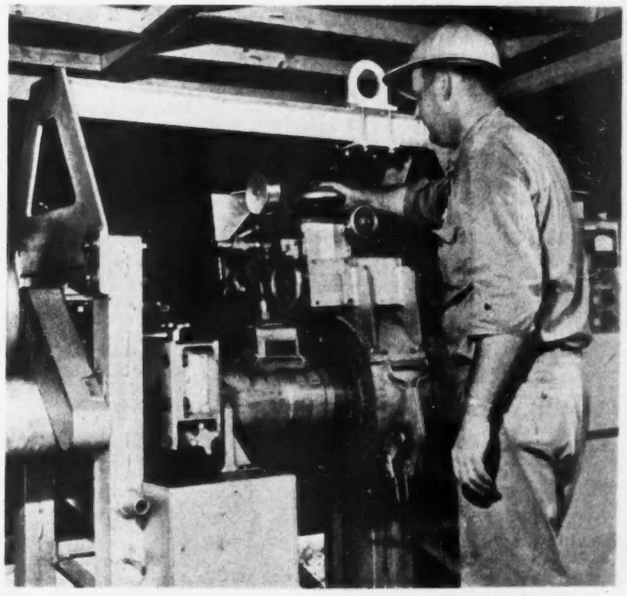
5. *The Engineering, Administration and Operation of Nuclear Facilities.*—This area of study is intended for those who will be in administrative positions at laboratories and power plants. It will consist of lectures, seminars, and on-the-job training. The course will be open to participants, though selected parts may be open to affiliates when approved by the Institute.

When the new International Institute begins instruction in February, programmes in all but the fifth area of instruction will be available to appointees. The engineering, administration and operation course sequence will start with the Institute's second semester, beginning in June, 1960. Brochures containing information about the Institute and application blanks are being distributed. They will be available to foreign students through their own governments, U.S. Embassies, the International Educational Exchange Service of the Department of State, Washington 25, D.C., and at other appropriate international organisations.

## Welded Aluminium Pipeline for Natural Gas

THE Aluminum Company of America, Pittsburgh, Pennsylvania, has completed the installation of a 4500ft long, 8in diameter aluminium pipeline in a 500 lb per square inch gas-gathering system at its Point Comfort works in Texas. Two new Alcoa developments—" Unistrength " pipe and a high-speed automatic pipe welding machine—were used for the first time. Buried without protection, the aluminium line cost only 4 per cent more than coated and wrapped steel lines of comparable size. It is claimed that this small premium is quickly overcome by the high corrosion resistance, maintenance of product quality, and the non-sparking characteristics of aluminium.

" Unistrength " pipe is a seamless, one-piece tubular product, that provides for efficient welded joints by having a heavier wall thickness at the pipe ends than along the length. A thinner wall along the pipe length sharply reduces pipe weight and substantially lowers material cost. At Point Comfort, the firm utilised 8in, Schedule 40 pipe in the American alloy 6063-T6. It was produced at the company's Lafayette works in Indiana. The nominal wall thickness at the pipe ends was 0·322in, while along the length it was 0·204in. Varying the wall thickness cut the pipe cost 20 per cent, compared to similar lines installed prior to the development of such pipe. Further savings were obtained by a new automatic pipe-welding machine, designed and developed by Alcoa. The welder is said to be the first machine capable of producing sound welds, with full penetration, without the use of back-up rings. This gain in welding technique, together with a high welding speed, resulted in less costly pipeline joints. The overall effect was to cut pipe-laying time, thus contributing to the reduction of the basic cost differential between aluminium and steel.



**Automatic pipe welding machine for the joining of 40ft sections of 8in diameter aluminium pipe**

# Personal and Business

## Appointments

PROFESSOR E. G. COX has been appointed to succeed Sir William Slater as secretary of the Agricultural Research Council.

THE EASTERN REGION OF BRITISH RAILWAYS announces the appointment of Mr. A. I. Emerson, A.M.I.C.E., as district engineer, Cambridge.

SIR W. H. BAILEY AND CO., Ltd., has appointed Mr. R. N. Bartley as north-eastern counties representative, to be responsible for Scotland also.

MR. KEITH H. KINGSLEY and Mr. George A. Kozloff have been appointed directors of Chrysler Motors, Ltd., and Dodge Brothers (Britain), Ltd.

MR. NORMAN ARTHUR HENRY TOMBLIN has been appointed secretary to the British Electrical Power Convention in succession to Mr. J. W. Simpson.

SANDERSON BROTHERS AND NEWBOULD, Ltd., announces that Mr. J. Woodiwiss has been appointed publicity manager in succession to Mr. G. B. Callan.

MR. R. E. BURNETT, A.M.I.E.E., general manager of Marconi Instruments, Ltd., has been elected to the board and appointed managing director of the company.

THE PLESSEY COMPANY, Ltd., announces that Mr. R. G. Kenwright has joined the company as chief engineer, television components division, components group, Ilford.

MR. F. R. BOND has been appointed a director of Worthington-Simpson, Ltd. He retains his office as secretary. Mr. H. D. Jenvey has been appointed assistant secretary.

MR. DUNCAN M. OPPENHEIM has been appointed chairman of the Council of Industrial Design in succession to Sir Walter Worboys who retires on January 31, 1960.

THE JUNIOR INSTITUTION OF ENGINEERS announces that Mr. E. M. Baskerville has been elected chairman and Mr. E. E. Burrage, M.I.Mar.E., and Mr. J. P. McKenna have been elected vice-chairmen.

MR. DERMOT H. DE TRAFFORD has been appointed chairman of Hugh Smith and Co. (Possil), Ltd., in succession to Mr. Robert Strachan. Mr. Strachan has retired at his own request, but he will continue to serve as a director.

THE MINISTRY OF AVIATION announces that Group Captain E. M. T. Howell has been appointed director of air armament research and development with effect from January 1, 1960, in succession to Air Commodore R. H. E. Emson.

E.C.C. CANADA, Ltd., the Canadian organisation owned by The Electric Construction Company, Ltd., and George Ellison, Ltd., has announced the appointment of Mr. V. Southon, A.I.E.E., as chief inside sales engineer and office manager at its Toronto office.

ENGLISH ELECTRIC VALVE COMPANY, Ltd., has announced that Mr. A. J. Young, M.I.E.E., general manager, has been elected to the board and appointed managing director of the company. Mr. F. N. Sutherland, M.I.E.E., has been elected to the board of directors.

THE ROYAL SOCIETY announces that at its anniversary meeting Sir Cyril Hinshelwood was re-elected president. The other officers re-elected for the ensuing year were : Sir William Penney, treasurer ; Sir Lindor Brown, biological secretary ; Sir William Hodge, physical secretary ; Dr. H. G. Thornton, foreign secretary.

## Business Announcements

W. G. BAGNALL, Ltd., states that its new London office is located at 1, Hay Hill, London, W.1 (telephone Hyde Park 1778/9).

MACKAY INDUSTRIAL EQUIPMENT, Ltd., has opened a northern depot at Wheatley Hall Road, Doncaster, Yorkshire (telephone, Doncaster 66353).

WOLF ELECTRIC TOOLS, Ltd., states that its Bristol branch has moved into new premises at 1–3, Dean Street, Bristol, 2 (telephone, Bristol 22288).

CANATLAS STEELS (ENGLAND), Ltd., Cradock Road, Luton, Beds, the British subsidiary of Atlas Steels, Ltd., of Welland, Canada, has changed its name to Atlas Steels (England), Ltd.

HAWTHORN LESLIE (SHIPBUILDERS), Ltd., announces that Mr. Christopher Stephenson, M.C., who has been general manager of the company since 1941, and a director since 1955, will retire at the end of the year.

R. H. CORBETT AND CO., Ltd., Hydrum Works, Burgess Hill, Sussex, is to move to the premises of its parent company, Woodfield Rochester, Ltd., Frindsbury Works, Rochester, Kent (telephone, Strood 78421), with effect from February 1, 1960.

BRITISH ANZANI ENGINEERING COMPANY, Ltd., Windmill Road, Hampton Hill, Middlesex, has been appointed sole concessionnaire for the United Kingdom and Eire for the multi-pitch propeller made by the Lesnor-Maehr Marine Company, Inc., of Long Island, New York.

ALLIED IRONFOUNDERS, Ltd., 28, Brook Street, London, W.1, and LUNDELL (GREAT BRITAIN), Ltd., announce that Allied Ironfounders has signed an agreement to acquire a controlling interest in Lundell who market flail forage harvesters, manufactured in this country under licence to American designs.

DORMAN LONG AND CO., Ltd., G.P.O. Box No. 1, Zetland Road, Middlesbrough, has acquired a controlling interest in T.A. Holdings, Ltd. The company has two overseas subsidiary companies—Amalgamated Engineering Company, Ltd., and Amalgamated Engineering Company (Ghana), Ltd.

BABCOCK AND WILCOX, Ltd., Babcock House, 209, Euston Road, London, N.W.1, states that under an agreement announced by Univeral Marion Corporation, Marion Power Shovel Company excavators and cranes will be manufactured at its Dalmuir Works, Scotland. These machines will be marketed and serviced by Blackwood Hodge and Co., Ltd., 25, Berkeley Square, London, W.1.

MARCONI'S WIRELESS TELEGRAPH COMPANY, Ltd., Chelmsford, Essex, has formed a closed circuit television division and in this connection the following new appointments have been made : Mr. V. J. Cooper has been appointed manager and chief engineer of the division ; Mr. J. E. H. Brace, deputy manager and chief of sales and contracts, and Mr. N. N. Parker-Smith, chief development engineer. In the broadcasting division the following appointments have been made : Mr. G. E. Partington has been appointed chief engineer, and Mr. J. F. James, chief development engineer.

MASSEY-FERGUSON has announced that a single management group has been established with the title United Kingdom Operations, to control and co-ordinate all Massey-Ferguson operating activities in the United Kingdom. Mr. A. A. Thornbrough, president of the parent company, has assumed executive direction of United Kingdom Operations as managing director, and Mr. Lionel Harper has been appointed assistant managing director. Massey-Ferguson (Great Britain), Ltd., has changed its name to Massey-Ferguson (United Kingdom), Ltd. Mr. Eric Young has been appointed deputy managing director of Massey-Ferguson (United Kingdom), Ltd.

INTERNATIONAL COMPUTERS AND TABULATORS, Ltd., Gloucester House, 149, Park Lane, London, W.1, states that, following the merger in January this year of The British Tabulating Machine Company, Ltd., and Powers-Samas Accounting Machines, Ltd., the Hollerith and Powers-Samas interests in Australia have been taken over by a new company, to be known as International Computers and Tabulators Australia Pty., Ltd. The new company has been formed by Hollerith (Australia) Pty., Ltd., and the Powers-Samas division of Kalamazoo (Australia), Ltd. The chairman of the new company is Sir Alexander Fitzgerald and the deputy chairman is Mr. C. W. R. Boyce. The other directors are Messrs. F. G. Dowding, W. H. Jones, E. C. Howie, and G. A. Redhouse.

SHELL CHEMICAL COMPANY, Ltd., 170, Piccadilly, London, W.1, and O. and M. KLEEMANN, Ltd., announce the termination as from January 1, 1960, of the agency agreement under which O. and M. Kleemann's subsidiary, Erinoid, Ltd., markets Polystyrene manufactured by Shell Chemical's associate, Styrene Products., Ltd. It is also announced that Erinoid will no longer act as agent for the sale of Ziegler Polyethylene manufactured by Shell. From January 1, 1960, Shell Chemical will be marketing identical grades of Polystyrene under the trade mark "Carinex" through its regional marketing organisation, and continuing the marketing of "Carlona" high density Polyethylene. Erinoid will continue to sell both its own manufactures and its own grades of Polystyrene and Polyethylene. The arrangements under which Styrene Products, Ltd., manufacture Polystyrene for Kleestron, Ltd., another Kleemann subsidiary, remain unchanged.

## Contracts

HUMPHREYS AND GLASGOW, Ltd., has received a contract from Colonial Gas Holdings for a blue water gas plant to be built at Box Hill, a residential suburb 9 miles outside Melbourne, Australia. The new plant, which will cost about £A90,000, will be producing 1,500,000 cubic feet of gas a day on completion at the end of 1960. The gas, which is of low calorific value, will be enriched by liquefied petroleum gas (propane) before distribution.

BRISTOL SIDDELEY ENGINES, Ltd., has received from the Defence Agency of Japan an order for a "substantial quantity" of "Orpheus" 805 turbojets of 4000 lb thrust for installation in the Fuji TIF-2, standard advanced/intermediate trainer of the Japanese Air Self-Defence Force.

REED AND MALLIK, and THE BRAITHWAITE COMPANY have been awarded a contract by the Tasmanian Government to construct a new bridge over the River Derwent near Hobart. The bridge, a high level, four-lane structure on piles, will replace Hobart's famous floating arch bridge of concrete pontoons which, after sixteen years, is now nearing the end of its useful life. Work on the new bridge is expected to start early next year and take about three years.

MULLARD EQUIPMENT, Ltd., has received an order worth £50,000 from the Soviet Union for a 4,000,000V linear accelerator designed for X-ray treatment of deep-seated tumours. It is the first British equipment of its kind to be ordered by the U.S.S.R., and will be installed in Moscow. The machine will be similar in design to those built by the company for hospitals in Great Britain but with technical improvements, which will give the machine a larger X-ray field for a given output, reduce the time needed to set-up for treatment, and confer greater flexibility in control.

BABCOCK AND WILCOX, Ltd., is to supply to the Central Electricity Generating Board a 550MW pulverised-coal-fired Radiant boiler, worth over £5,500,000, for commissioning in 1964 at Thorpe Marsh power station, near Doncaster, Yorks. It will be the largest single-furnace boiler in the world and will burn about 200 tons of coal an hour (5000 tons a day) to produce 3,750,000 lb (1675 tons) of steam per hour. When completed it will be about 170ft high and will have a single, fusion-welded high-pressure steam drum 130ft long, weighing about 265 tons. The boiler will supply steam to the 550MW turbo-alternator at a pressure of 2400 lb per square inch and a temperature of 1055 deg. Fah., with reheating after partial expansion through the turbine.

ASSOCIATED ELECTRICAL INDUSTRIES, Ltd. (HEAVY PLANT DIVISION), has secured a contract from Norway for a 108,000kW rectifier installation required by Ardal og Sunndal Verk, for extensions to the aluminium smelting plant at Ardal, at the head of the Sognefjord on the west coast of Norway ; this company is the largest producer of aluminium in Norway and the new extensions represent an increase in production capacity of 32,000 tons per annum. The order covers semiconductor rectifier equipment rated at 135,000A, 800V d.c., and the plant is to be commissioned and in commercial operation early in 1962. The transformers required to operate with the rectifier equipment will be manufactured in Norway by A/S Rich Pfeiffer, with whom A.E.I. have collaborated in the overall design of the installation. Consultative and technical services in the design and layout of the electrical plant are to be provided by A.E.I.

## Miscellanea

FUNNEL FOR FUEL.—Simmonds Aerocessories, Ltd., has introduced a filter-funnel for use when fuel is loaded into barrels, aircraft tanks, or other vessels, in order to supersede such crude strainers as chamois leather. The funnel incorporates two Fram filter-separator cartridges which remove water and solid matter ; the water is directed to a sump which can be drained. The funnel weighs 16 lb and the cartridges last a year. The maximum flow is 25 Imperial gallons per minute.

STRAIGHT ACTION TOGGLE CLAMP.—A new clamp made by Speed Tools, Ltd., Vereker House, Gresse Street, London, W.1, for use in fixtures, machine tools or in similar applications has a form of toggle action by which the clamping spindle follows an almost vertical path throughout its travel with a straight down motion over the final ¼in of its final closing movement. With this vertical movement the clamping spindle can be arranged to enter or withdraw from a locating hole accurately to locate and clamp components simultaneously.

DIESEL HYDRAULIC LOCOMOTIVE "D 800."—In connection with the article "Diesel Hydraulic Locomotive 'D 800'" giving abstracts from a paper presented to the Institution of Locomotive Engineers, which appeared in our issue of November 20 last, we have received a correction from the author, Mr. G. E. Scholes. This correction refers to the fuel consumption curve on page 647. The statement "The fuel consumption per *rail horsepower-hour* corresponding to Fig. 5 is given in Fig. 8," should read "The fuel consumption per *engine brake horsepower* corresponding to Fig. 5 is given in Fig. 8."

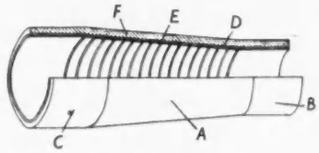
# British Patent Specifications

*When an abridgment is not illustrated the specification is without drawings, unless otherwise stated. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification. Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 3s. 6d. each.*

## TELECOMMUNICATIONS

**823,565.** January 29, 1957.—CONNECTING DEVICE FOR WAVE GUIDES, Compagnie Générale D'Electricité, 54, Rue La Boetie, Paris (8e), France.

The object of the present invention is to provide connecting horns between wave guides of different diameter which comprise means for permitting the $TE_{01}$ waves to pass, while preventing the propagation of waves of the other types. The use of these horns is particularly advantageous for connecting a rectilinear section to a bent section, because it makes it possible to eliminate the parasitic oscillations which may have been generated when waves passed into this last section. One embodiment is shown in the drawing reproduced. The horn *A*, which connects



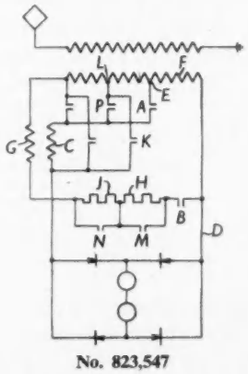

**No. 823,565**

two circular guides *B* and *C*, is formed of metallic rings *D* in the shape of truncated cones, of regularly increasing mean diameter, arranged one after the other so as to form a surface in the form of the frustum of a cone, of which the internal walls are perfectly smooth. Each of these rings is separated from the next by a narrow insulating ring *E*, so as to create an electrical discontinuity between the rings, and thus to prevent the transmission of waves with an electric field. The various rings are kept in place by means of an external sheath *F*, which may be a continuous sheath of thermo-plastic material or of soft metal such as lead, or may consist of a winding of paper tapes or of metallic ribbon, for example steel. This sheath, in addition to maintaining the rings in place, ensures their mechanical protection and also the mechanical connection between the horn and the two guides to be connected. In an alternative construction the horn is formed by winding a fine wire in contiguous turns on a mandrel in the shape of a truncated cone, which is then removed. The two ends of the spiral so formed are fixed, for example, by soldering, to the ends of the guides and a sheath is then applied to the whole.—*November* 11, 1959.

## ELECTRIC TRACTION

**823,547.** March 21, 1956.—ALTERNATING CURRENT ELECTRIC TRACTION EQUIPMENTS, Metropolitan-Vickers Electrical Company, Ltd., St. Paul's Corner, 1-3, St. Paul's Churchyard, London, E.C.4. (*Inventor: William Train Gray.*)

This invention is eminently applicable in traction equipments of the kind wherein the traction motors are supplied with direct current by means of mercury arc or like rectifiers connected with the secondary winding of the power transformer. It enables a large number of steps to be obtained with a comparatively small number of switches. The drawing

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is an electrical circuit diagram showing the main power circuits in one embodiment of the invention. In operation, on the first notch the contactor *A* is closed, together with the contactor *B*. The auxiliary transformer secondary winding *C* is thus connected in series between the conductor *D* and the lowest voltage tapping *E* of the main transformer secondary winding *F* and the auxiliary transformer primary winding *G* is energised from the main secondary winding with the resistance sections *H* and *J* in circuit. A corresponding voltage somewhat above that of the tapping *E* will therefore be applied to the traction motors. On the second and third notches resistances *H* and *J* are short-circuited in turn. In order further to accelerate the motors, transition to the fourth notch is effected in three steps. On step 1 the contactor *K* is closed. The secondary winding *C* is thus connected in parallel with the section of the main transformer secondary between tappings *E* and *L*. The auxiliary transformer is arranged so that when the primary winding *G* is connected directly across the main secondary winding *F* the secondary voltage of the auxiliary transformer is equal to that between the tappings of the main transformer so that contactor *A* carries virtually zero current. The contactor *A* is opened on transition step 2 and the contactors *B*, *M* and *N* are then also all opened. The traction motors are therefore at this stage connected directly between the conductor *D* and the tapping *L*. On transition step 3 the contactor *P* is closed thereby connecting the upper end of the winding *C*, also, with the tapping *L*, and the contactor *B* is also re-closed. The transition is completed at the fourth notch, wherein contactor *K* is opened, leaving the secondary winding *C* in series with the tapping *L* of the main secondary winding. The voltage applied to the motors is thus increased above that of the tapping *L* by an amount determined by the resistance *H*, *J*. On the fifth and sixth notches the contactors *M* and *N* are closed in turn to increase the primary current and secondary voltage of the auxiliary transformer, with corresponding increases in the motor voltage. Further progression follows a similar sequence. The equipment may be designed for continuous operation on all or some only of the total number of notches provided. A typical scheme might provide 36 notches with six tappings.—*November* 11, 1959.

## ELECTRONICS

**823,406.** October 16, 1957.—NAVIGATIONAL SYSTEMS, Minister of Supply, London. (*Inventor: Arnold George Ward.*)

According to this invention a navigational system for operation over a given area comprises a group of at least two spaced radio transmitting stations each adapted to transmit radio signals corresponding to the raster of a television picture of a map of the area and a continuously rotating vector displayed on the raster, its centre of rotation being positioned therein according to the map position of its transmitting station. Each station has an aerial system defining a directional transmission beam which rotates in synchronism with the rotating vector, whereby a television receiver whose position is cut by the transmission beams in their rotation will, as a beam passes through its position, display a picture of the corresponding vector, and the intersection of two vectors will provide an indication of the position of the receiver. The rotations of the aerials are not necessarily synchronised, although the speeds of rotation are substantially the same. The vectors do not appear on the receiver screen at the same time and so arrangements are made for the operator to draw each vector as it appears, or a long afterglow tube may be used. A map of the area in which the receiver is located is conveniently superimposed upon the television picture by means of a transparency or by the use of video mapping techniques. A refinement in the system, which avoids the need for providing the map at the receiver, is the addition of a third radio transmitting station adapted to transmit, omni-directionally, a picture of the map. By this means not only the map but additional information can be made available at the receiver; for instance in the case of an aircraft navigational system not only is position given on the picture of the map but information concerning weather, landing conditions and so forth can be added.—*November* 11, 1959.

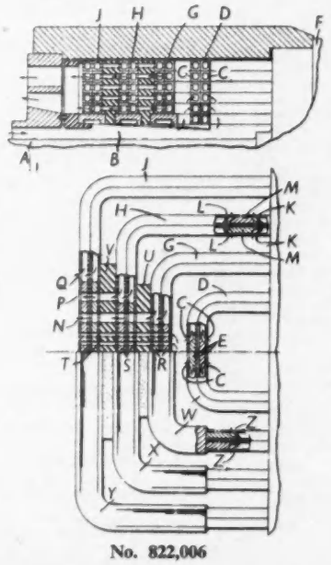
**823,451.** April 9, 1957.—RADAR SYSTEMS, Marconi's Wireless Telegraph Company, Ltd., Marconi House, Strand, London, W.C.2. (*Inventor: Alan Wheatley Dale.*)

Radar stations may be seriously interfered with, either deliberately or accidentally, by pulse signals which are received by the receiving equipment of the station, but which are not the desired echo pulses resulting from reflection at a target of pulses transmitted by the station. In general, such interfering pulses will not occur at the pulse repetition frequency employed by the station, and the present invention seeks to eliminate or reduce the adverse effects of such interfering pulses if they are greater in amplitude than the general radar noise level of the station. The specification describes means for separating all received signal pulses exceeding a predetermined amplitude, means for delaying separated pulses for a time delay equal to the pulse repetition period of the station, and for suppressing the display of signals when delayed separated pulses and undelayed separated pulses occur out of time coincidence. The delay may be provided in any known convenient way, but one simple and preferred way is to use a magnetostrictive delay line. However, other forms of delay device may be used, among them being storage electron discharge tubes, mercury delay lines, and mechanically driven delay devices such as rotating magnetic drums or tapes with relatively displaced signal storing and signal pick-up devices.—*November* 11, 1959.

## ELECTRICAL ENGINEERING

**822,006.** April 1, 1955.—DYNAMO-ELECTRIC MACHINES, The English Electric Company, Ltd., Queens House, 28, Kingsway, London, W.C.2. (*Inventors: John William Harold Morgan and John Thomas Wilkins.*)

This invention relates to the direct cooling of at least some of the coil overhangs at each end of a generator rotor wound with hollow conductors through which a cooling medium is passed. The upper drawing is a sectional elevation of one of the winding overhangs of a two-pole hydrogen-cooled turbo-alternator, and the lower one is a view looking underneath the overhang. Hydrogen is fed by shaft portion *A* of the rotor to annular intake space *B* below the winding overhang. Inlet ports *C* are provided in the circumferentially extending portions of each turn of the coil *D* and hydrogen entering the hollow conductors via these ports is deflected in opposite directions around the turns by means of solid inserts *E*, to be exhausted via outlet ports in the coils located intermediate the ends of the slotted core portion *F*. Except for the radially innermost turn, each turn of the coils *G*, *H* and *J* is provided with inlet ports *K* and *L* in both coil sides adjacent the slotted core portion. The hydrogen entering the hollow conductors via the ports *L* is deflected by means of the solid inserts *M* around the coil overhangs. In the case of the coil *G*, the hydrogen is exhausted through axial outlet ducts *N*; in the case of the coil *H* the hydrogen is exhausted through axial outlet ducts *P*, whilst in the case of the coil *J*, the hydrogen is exhausted through outlet ports *Q*. In each case two outlets are provided in each turn, one on each side of the coil centre line. Solid inserts *R*, *S* and *T* are provided in each turn of the coils *G*, *H* and *J*




**No. 822,006**

respectively, whilst insulating packing pieces *U* and *V*, extending the full depth of the coils, are provided between the coils *G* and *H* and between the coils *H* and *J* respectively. The overhang portion of the radially innermost turn of each of the coils *G*, *H* and *J* is cut away so as to leave only a short length of the straight parts of the turns overhanging the end of the slotted core portion and solid rectangular connectors *W*, *X* and *Y* respectively are butt-welded to the ends of the hollow conductors. Hydrogen entering inlet ports *Z* in coils *G*, *H* and *J* is deflected by solid inserts towards the centre of the rotor where it is exhausted into the air gap through radial ports, not shown. The solid rectangular connectors are cooled by means of the main flow of hydrogen under the winding overhangs, and in order to achieve a temperature gradient along these connectors which is approximately the same as that of the hollow turns, grooves are formed therein.—*October* 21, 1959.

# Forthcoming Engagements

*Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office not later than a fortnight before the meeting. In all cases the* TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

### ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS

*To-day, Dec.* 11.—STOKE AND CREWE BRANCH: Royal Hotel, Crewe, "Recording Instruments," J. Campaigne and P. Death, 7.30 p.m.

*Mon., Dec.* 14.—NORTH WEST LONDON BRANCH: Century Hotel, Wembley, "Acrylic Plastics in Lighting," J. B. Clark, 8.15 p.m.

*Tues., Dec.* 15.—LONDON NATIONAL LECTURE: Royal Institution, 21, Albemarle Street, London, W.1, "Impressions of the Antipodes," Rt. Hon. The Lord Citrine, 6.30 p.m. ★ OXFORD AND DISTRICTS BRANCH: Employment Exchange, Oxford, "Planned Maintenance," F. Galloway, 8 p.m. ★ ALDERSHOT AND DISTRICTS BRANCH: Queens Hotel, South Farnborough, Hants, Films Evening, 7.30 p.m.

*Wed., Dec.* 16.—NOTTINGHAM BRANCH: E.M.E.B. Showroom Theatre, Cannington Street, Nottingham, Annual Film Evening, 7.30 p.m. ★ WOLVERHAMPTON AND DISTRICTS BRANCH: Chamber of Commerce, District Bank Chambers, Lichfield Street, Wolverhampton, Open Forum, 7.45 p.m.

*Thurs., Dec.* 17.—SOUTH LONDON BRANCH: Greyhound Hotel, High Street, Croydon, Surrey, "Electronics in Industry," S. H. Rose, 8 p.m.

### BRITISH COMPUTER SOCIETY

*Thurs., Dec.* 17.—LONDON BRANCH: Northampton College of Advanced Technology, St. John Street, London, E.C.1, Discussion on "Conversion between Analogue and Digital Representation," 2.30 p.m. ★ SOUTH WALES AND MONMOUTHSHIRE BRANCH: Small Shandon Lecture Theatre, University College, Cardiff, "Mechanical Translation of Languages," J. P. Cleeve, 6.30 p.m. ★ LEICESTER BRANCH: Room 104, College of Technology, Leicester, Films, "The Electronic Computer in Commerce," and "Time to Think," 7 p.m.

### BRITISH INSTITUTION OF RADIO ENGINEERS

*Tues., Dec.* 15.—LONDON SECTION: London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1, Half-day Symposium on "Magnetic Recording Techniques," 3 p.m. and 6 p.m.

*Wed., Dec.* 16.—MEDICAL ELECTRONICS GROUP: London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1, "Measurements in the Presence of Noise," D. A. Bell, 6.30 p.m.

*Thurs., Dec.* 17.—SOUTH WESTERN SECTION: School of Management Studies, Unity Street, Bristol, "The Transistor and its Use in Communication and Control Equipment," E. Wolfendale, 7 p.m. ★ SCOTTISH SECTION: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, "The Digital Voltmeter," J. A. Irvine and D. A. Pucknell, 7 p.m.

*Fri., Dec.* 18.—SCOTTISH SECTION: Department of Natural Philosophy, The University, Drummond Street, Edinburgh, "The Digital Voltmeter," J. A. Irvine and D. A. Pucknell, 7 p.m.

### CEMENT AND CONCRETE ASSOCIATION

*Tues., Dec.* 15.—Mid-Warwickshire College of Further Education, Warwick New Road, Leamington Spa, "Weathering and Deterioration of Concrete and Cement Renderings," C. Hobbs, 7.15 p.m.

*Wed., Dec.* 16.—College of Further Education, Northgate Building, Darlington, "Practical Formwork Design and Construction for Concrete," J. G. Richardson, 7.15 p.m.

### COMBUSTION ENGINEERING ASSOCIATION

*Tues., Dec.* 15.—NORTH WESTERN REGION: Engineers' Club, Albert Square, Manchester, "Heat Insulation," Martin Edge, and R. A. Mansergh, 2.30 p.m.

### DIESEL ENGINEERS AND USERS' ASSOCIATION

*Thurs., Dec.* 17.—Institute of Marine Engineers, Memorial Building, 76, Mark Lane, London, E.C.3, "Report on Heavy Oil Engine Working Costs and Performance, 1958-59"; Informal Discussion on "Operating Problems"; and "The Inventions of B.I.C.E.R.A.," W. P. Mansfield, 2.30 p.m.

### ILLUMINATING ENGINEERING SOCIETY

*Mon., Dec.* 14.—SHEFFIELD CENTRE: Grand Hotel, Sheffield, Technical Film Show, 6.30 p.m.

*Tues., Dec.* 15.—LIVERPOOL CENTRE: Merseyside and N. Wales Electricity Board Industrial Development Centre, Liverpool, "New Developments in the Calculation of Co-efficients of Utilisation," W. Robinson, 6 p.m.

### INSTITUTE OF BRITISH FOUNDRYMEN

*Tues., Dec.* 15.—SLOUGH SECTION: Lecture Theatre, High Duty Alloys, Ltd., Slough, "Running and Gating of Castings," W. W. Glick, 7.30 p.m.

*Wed., Dec.* 16.—LONDON BRANCH: Constitutional Club, Northumberland Avenue, London, W.C.2, "Aluminium Castings," J. Vickers, 7.30 p.m.

*Mon., Dec.* 21.—EAST ANGLIAN SECTION: Lecture Hall, Public Library, Ipswich, Film evening, 7.30 p.m.

### INSTITUTE OF MARINE ENGINEERS

*Mon., Dec.* 14.—WEST OF ENGLAND SECTION: Small Engineering Lecture Theatre, The University, University Walk, Bristol, 8, Films, "Adma for Short"; "Birth of a Tanker"; "Tanker Story" and "Special Marine Cylinder Lubricants," 7.30 p.m.

*Tues., Dec.* 15.—JOINT NUCLEAR MARINE PROPULSION PANEL: Memorial Building, 76, Mark Lane, London, E.C.3, "Some Aspects of Marine Reactor Safety," K. Maddocks, 5.30 p.m.

*Wed., Dec.* 16.—KINGSTON UPON HULL AND EAST MIDLANDS SECTION: Royal Station Hotel, Kingston upon Hull, Joint Meeting with the Hull Association of Engineers, "Steam and Steam Generation," J. Anderson, 7.30 p.m.

### INSTITUTE OF METAL FINISHING

*Wed., Dec.* 16.—BIRMINGHAM ORGANIC FINISHING GROUP: Engineering Centre, Stephenson Place, Birmingham, 2, "Polyurethane Finishes and Foams," R. Hurd, 6.30 p.m.

### INSTITUTE OF NAVIGATION

*Fri., Dec.* 18.—Royal Geographical Society, 1, Kensington Gore, London, S.W.7, Film meeting, 5.15 p.m.

### INSTITUTE OF PETROLEUM

*Wed., Dec.* 16.—Lecture Theatre, 61, New Cavendish Street, London, W.1, Redwood Lecture, "Pipelines," and Presentation of Redwood Medal to A. C. Hartley, 5.30 p.m.

### INSTITUTE OF ROAD TRANSPORT ENGINEERS

*To-day, Dec.* 11.—SOUTH WALES CENTRE: South Wales Institute of Engineers, Park Place, Cardiff, "Glass Fibre Reinforced Plastics," G. O. Gurney, 7.15 p.m.

*Thurs., Dec.* 17.—METROPOLITAN AREA: Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2, "A Review for the Selection, Specification and Design of a Commercial Vehicle," E. B. H. Elsbury, 6.30 p.m. ★ YORKSHIRE CENTRE: Great Northern Hotel, Wellington Street, Leeds, 1, "Diesel Power Units," D. Kaberry, 7.30 p.m.

### INSTITUTE OF WELDING

*Wed., Dec.* 16.—NORTH LONDON BRANCH: Works Visit to British Oxygen Company, Ltd., Angel Road, London, N.18, 7.30 p.m.

### INSTITUTION OF BRITISH AGRICULTURAL ENGINEERS

*Mon., Dec.* 14.—NORTHERN CENTRE: North Eastern Electricity Board Lecture Theatre, Carliol House, Newcastle upon Tyne, "Mechanical Handling and Preparation of Feeding Stuffs on the Farm," John T. Taylor, 6.45 p.m. ★ SCOTTISH CENTRE: North of Scotland Hydro-Electric Board, Blackfriars, Perth, "Accident Prevention on Farms," J. Brownlie, 7.30 p.m.

### INSTITUTION OF CIVIL ENGINEERS

*Tues., Dec.* 15.—Great George Street, Westminster, London, S.W.1, Joint Meeting with the British Section of Société des Ingénieurs Civils de France, "New Dam Techniques," André Coyne, 5.30 p.m.

### INSTITUTION OF ELECTRICAL ENGINEERS

*To-day, Dec.* 11.—E. MIDLAND CENTRE: College of Technology, Leicester, "Electrical Floor Warming," J. W. Moule and W. M. Stevenson, 7 p.m. ★ N. SCOTLAND SUB-CENTRE: Robert Gordon Technical College, Aberdeen, "Automatic Digital Recording of Experimental Values," W. H. P. Leslie, 7.30 p.m. ★ N. STAFFORDSHIRE SUB-CENTRE: Technical College, Stoke-on-Trent, "Discrimination between H.R.C. Fuses," E. Jacks, 7 p.m.

*Mon., Dec.* 14.—INFORMAL MEETING: Savoy Place, London, W.C.2, Discussion on "Why Hi-Fi?" opened by P. P. Eckersley, 5.30 p.m. ★ MERSEY AND NORTH WALES CENTRE: Town Hall, Chester, Joint Meeting with the North-Western Association of the Institution of Civil Engineers, "Generator/Motor Problems in Pumped Storage Installations," J. H. Walker, 6.30 p.m. ★ NORTH EASTERN CENTRE: Neville Hall, Westgate Road, Newcastle upon Tyne, Diamond Jubilee Lecture, J. R. Beard, 6.15 p.m. ★ SHEFFIELD SUB-CENTRE: Angel Hotel, Brigg, Discussion on "Planning and Development of Factory and Public Supply Electrical Systems," 6.45 p.m. ★ WESTERN CENTRE: Reardon Smith Hall, Cardiff, Joint Meeting with the Supply and Utilisation Groups, "The Provision of Adequate Electrical Installations in Buildings,"—(*a*) "Multi-Storey Flats and Maisonettes," C. A. Belcher, and (*b*) "Small Industrial Premises," J. A. Sharp, 6 p.m.

*Tues., Dec.* 15.—MEASUREMENT AND CONTROL SECTION: Savoy Place, London, W.C.2, Discussion on "Data Handling Problems in Atomic Installations," opened by D. Taylor, 5.30 p.m. ★ NORTH MIDLAND CENTRE: Electrical Engineering Department Lecture Theatre, The University, Leeds, "Investigations of Power Follow-Current Phenomena using a Synthetic Power Source," L. L. Alston and F. M. Bruce, and "The Impulse Initiation of Arc Discharges," L. L. Alston, 6.30 p.m. ★ SOUTHERN CENTRE: Technical College, Farnborough, "Subscriber Trunk Dialling," D. A. Barron, 6 p.m.

*Wed., Dec.* 16.—ELECTRONICS AND COMMUNICATIONS SECTION: Savoy Place, London, W.C.2, "The Laying of Submarine Cables," W. H. Leech, 5.30 p.m. ★ SHEFFIELD SUB-CENTRE: Grand Hotel, Sheffield, "Research on the Performance of High-Voltage Insulators in Polluted Atmospheres," J. S. Forrest, P. J. Lambeth and D. F. Oakeshott, 6.30 p.m. ★ SOUTH WEST SCOTLAND SUB-CENTRE: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2, "The Provision of Adequate Electrical Installations in Buildings,"—(*a*) "Multi-Storey Flats and Maisonettes," C. A. Belcher and (*b*) "Small Industrial Premises," J. A. Sharp, 6 p.m.

*Thurs., Dec.* 17.—EDUCATION DISCUSSION CIRCLE: Savoy Place, London, W.C.2, Discussion on "The Presentation of the History and Philosophy of Science," opened by H. Dingle, 6 p.m. ★ SOUTH-WESTERN SUB-CENTRE: Electricity Showrooms, Bedford Street, Exeter, "Turbo-Generator Performance under Exceptional Operating Conditions," T. H. Mason, P. D. Aylett, and F. H. Birch, 3 p.m.

### INSTITUTION OF ENGINEERING DESIGNERS

*Wed., Dec.* 16.—YORKSHIRE BRANCH: Midland Hotel, Bradford, Ladies' Night and Film Evening, 7.30 p.m.

### INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND

*Tues., Dec.* 15.—39, Elmbank Crescent, Glasgow, "Refrigerated Ships," E. Russell Roberts, 6.30 p.m.

### INSTITUTION OF ENGINEERS-IN-CHARGE

*Wed., Dec.* 16.—Tudor Room, Caxton Hall, Westminster, London, S.W.1, "Gas Transmission in the United Kingdom," D. L. Copp, 6.30 p.m.

### INSTITUTION OF HIGHWAY ENGINEERS

*To-day, Dec.* 11.—Park Lane Hotel, Piccadilly, London, W.1, Annual General Meeting, 11.45 a.m.

### INSTITUTION OF LOCOMOTIVE ENGINEERS

*Tues., Dec.* 15.—Lecture Hall, Institution of Mechanical Engineers, 1, Birdcage Walk, London, S.W.1, "Methods of Reducing Flange Wear on Diesel and Electric Locomotives," W. L. Topham, 5.30 p.m.

### INSTITUTION OF MECHANICAL ENGINEERS

*To-day, Dec.* 11.—LUBRICATION GROUP: 1, Birdcage Walk, Westminster, London, S.W.1, Discussion on "Recognition of Deterioration of Lubricants in Service," 6 p.m.

*Mon., Dec.* 14.—MIDLAND GRADUATES' SECTION: Exchange and Engineering Centre, Stephenson Place, Birmingham, "Materials Handling in American Drop Forges," W. G. Kirkwood, 7 p.m.

*Tues., Dec.* 15.—MIDLAND BRANCH, RUGBY PANEL: College of Technology and Arts, Rugby, "Ship Propulsion in the Nuclear Age," E. Norton, 7.15 p.m. ★ LONDON GRADUATES' SECTION: Visit to James Pascall, Ltd., Mitcham, Surrey, 2.30 p.m. ★ SCOTTISH GRADUATES' SECTION: New Engineering Building, The University, Glasgow, "Cold Stores for the Future," S. Forbes Pearson, 7.30 p.m.

*Wed., Dec.* 16.—JAMES CLAYTON LECTURE: 1, Birdcage Walk, Westminster, London, S.W.1, "The Future of Air-breathing Engines in Aviation," S. G. Hooker, 6 p.m. ★ SOUTHERN BRANCH: Royal Star Hotel, Maidstone, "The Effect of Nuclear Radiation on Engineering Materials," A. H. Cottrell, 7.30 p.m. ★ N.E., A.D. CENTRE: The University, Leeds, 2, "Some Investigations on Cold-starting Phenomena in Diesel Engines," A. E. W. Austen and W. T. Lyn, 7.30 p.m. ★ EASTERN GRADUATES' SECTION: Visit to Early Generating Station, Reading, 7.30 p.m.

*Thurs., Dec.* 17.—N.E. BRANCH: Stephenson Building, Claremont Road, Newcastle upon Tyne, Informal Discussion Group, "The Energy Balance in Steam Power Plant Systems," R. S. Silver, 6.15 p.m. ★ YORKSHIRE BRANCH: The University, Leeds, "The Effect of Nuclear Radiation on Engineering Materials," A. H. Cottrell, 6.30 p.m.

*Mon., Dec.* 21.—SCOTTISH A.D. CENTRE: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2, "Construction and Behaviour Characteristics of Tyres," T. French, 7.30 p.m.

### INSTITUTION OF MINING AND METALLURGY

*Thurs., Dec.* 17.—Geological Society, Burlington House, Piccadilly, London, W.1, Papers for Discussion, "Relationship Between Particle Size and Collector Concentration," A. J. Robinson; "Deepening of No. 1 Vertical Shaft at Premier (Transvaal) Diamond Mining Company, Ltd.," D. Borchers, 5 p.m.

### INSTITUTION OF NAVAL ARCHITECTS

*Tues., Dec.* 15.—76, Mark Lane, London, E.C.3, "Some Aspects of Marine Reactor Security," K. Maddocks, 5.30 p.m.

### INSTITUTION OF PLANT ENGINEERS

*Wed., Dec.* 16.—KENT BRANCH: The Kings Head Hotel, High Street, Rochester, Social Evening and Members' One Minute Questions and Answers, 7 p.m. ★ LEICESTER BRANCH: Bell Hotel, Leicester, "Fibre Glass in Industry," R. Loughran, 7.30 p.m.

*Thurs., Dec.* 17.—BLACKBURN BRANCH: Castle Hotel, Blackburn, "Procedure to Avoid Disputes in the Engineering Industry," J. E. Norton, 7.30 p.m.

*Fri., Dec.* 18.—BIRMINGHAM BRANCH: Imperial Hotel, Temple Street, Birmingham, Mobile Plant Discussion Group, 7.30 p.m.

### INSTITUTION OF PRODUCTION ENGINEERS

*Mon., Dec.* 14.—LEEDS SECTION: Hotel Metropole, King Street, Leeds, 1, "Materials Purchase as an Aid to Production," D. H. Brandon, 7 p.m. ★ SHEFFIELD SECTION: Grand Hotel, Sheffield, "Fabrication of Heavy Steel Components," W. Plews, 7.15 p.m.

*Wed., Dec.* 16.—SWANSEA SECTION: Central Library, Swansea, "Lighting and Colour as an Aid to Production," R. Davies, 7 p.m.

*Thurs., Dec.* 17.—GLASGOW SECTION: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2, "Welding and Marine Engineering," J. A. Dorrat, 7.30 p.m.

### INSTITUTION OF THE RUBBER INDUSTRY

*To-day, Dec.* 11.—LEICESTER SECTION: Bell Hotel, Leicester, "The Utilisation of Man-made Fibres in the Rubber Industry," G. A. Pittman, 7.30 p.m.

*Mon., Dec.* 14.—MANCHESTER SECTION: Engineers' Club, Albert Square, Manchester, "Stress Relaxation Measurements in the Investigation of Ageing of Vulcanisates," J. Scanlan, 6.45 p.m. ★ MIDLAND SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham, "Ageing and Weathering of Rubber and some Plastics," W. McG. Morgan, 6.45 p.m. PRESTON SECTION: B.T.R. Industries Social Club, Farrington, Preston, Lancs, "Education in Industry," R. F. Marshall, 7.15 p.m.

### INSTITUTION OF STRUCTURAL ENGINEERS

*To-day, Dec.* 11.—WESTERN COUNTIES BRANCH: University Engineering Laboratories, Bristol, "Welded Tubular Structures," G. B. Godfrey, 6 p.m.

*Tues., Dec.* 15.—SCOTTISH BRANCH: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2, "'Goliath' Crane at Hunterston Atomic Power Station," A. Henderson, 7 p.m.

### JUNIOR INSTITUTION OF ENGINEERS

*To-day, Dec.* 11.—Pepys House, 14, Rochester Row, Westminster, London, S.W.1, Induction of President, J. M. Kay, and Presentation of Awards by W. M. Larke: "The Engineer's Role in Nuclear Power," 7.30 p.m. ★ NORTH WESTERN SECTION: Engineers' Club, Albert Square, Manchester, "Fitting an Escalator in a Ship," D. H. Clark, 7.30 p.m.

*Mon., Dec.* 14.—SHEFFIELD SECTION: Livesey Clegg House, 44, Union Street, Sheffield, 1, "Compressors and Compressed Air Equipment," L. Hancock, 7.30 p.m.

*Fri., Dec.* 18.—INFORMAL MEETING: Pepys House, 14, Rochester Row, Westminster, London, S.W.1, "Radioisotopes in Industry," W. G. Busbridge, 7 p.m.

### MANCHESTER ASSOCIATION OF ENGINEERS

*To-day, Dec.* 11.—Engineers' Club, Albert Square, Manchester, 2, "Recent Developments in Shaft Sinking Techniques," W. R. Spendlove, 6.45 p.m.

### NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS

*To-day, Dec.* 11.—Lecture Theatre, Mining Institute, Newcastle upon Tyne, "Ship Model Size and Tank Boundary Correction," A. Emerson, 6.15 p.m.

### PLASTICS INSTITUTE

*Wed., Dec.* 16.—YORKSHIRE SECTION: St. Mark's House, 186, Woodside Lane, Leeds, 2, "Electrical Heating for the Plastics Industry," A. Westerman, 7.15 p.m.

### REINFORCED CONCRETE ASSOCIATION

*Tues., Dec.* 15.—MIDLAND COUNTIES BRANCH: Birmingham and Midland Institute, Paradise Street, Birmingham, "The Design and Construction of the Shell Roof of the Exhibition Palace of the National Centre of Industries and Technology, Paris," J. E. C. Farebrother, 6 p.m.

### ROYAL AERONAUTICAL SOCIETY

*To-day, Dec.* 11.—Institution of Mechanical Engineers, 1, Birdcage Walk, London, S.W.1, Symposium on "Flight Safety," 10 a.m. ★ AGRICULTURAL AVIATION GROUP: Library, 4, Hamilton Place, London, W.1, "Aerial Operations Planning in the United Kingdom: Results and Difficulties," P. King, 7 p.m.

### ROYAL STATISTICAL SOCIETY

*To-day, Dec.* 11.—GENERAL APPLICATIONS SECTION: Royal Institute of Public Health and Hygiene, 28, Portland Place, London, W.1, "Pitfalls in the Collection of Agricultural Statistics," H. Palca, 6.15 p.m.

*Fri., Dec.* 18.—INDUSTRIAL APPLICATIONS SECTION: London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1, Half-day Conference on "Experimentation—in Theory and Practice," 2 to 7 p.m.

### SCIENCE MUSEUM—CHRISTMAS LECTURES FOR BOYS AND GIRLS

*Tues. and Wed., Dec.* 22 *and* 23.—Science Museum, South Kensington, London, S.W.7, "From Man Power to Atomic Power," Victor Wall, 2.30 p.m.

*Mon. and Tues., Dec.* 28 *and* 29.—Science Museum, South Kensington, London, S.W.7, "From Tinfoil to Tape: The History of the Gramophone," John Cain, 2.30 p.m.

### SOCIETY OF CHEMICAL INDUSTRY

*Wed., Dec.* 16.—CORROSION GROUP: 14, Belgrave Square, London, S.W.1, Discussion of Research Papers recently published by Members of the Group, 6 p.m.

### SOCIETY OF INSTRUMENT TECHNOLOGY

*Wed., Dec.* 16.—CONTROL SECTION: Manson House, 26, Portland Place, London, W.1, "Random Inputs and Load Variations," J. F. Coales, 6.30 p.m.

### WEST OF SCOTLAND IRON AND STEEL INSTITUTE

*Fri., Dec.* 18.—Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2, "Self-Fluxing Sinter," E. H. Baldwin, I. M. Mathieson and D. McNeil, 6.45 p.m.

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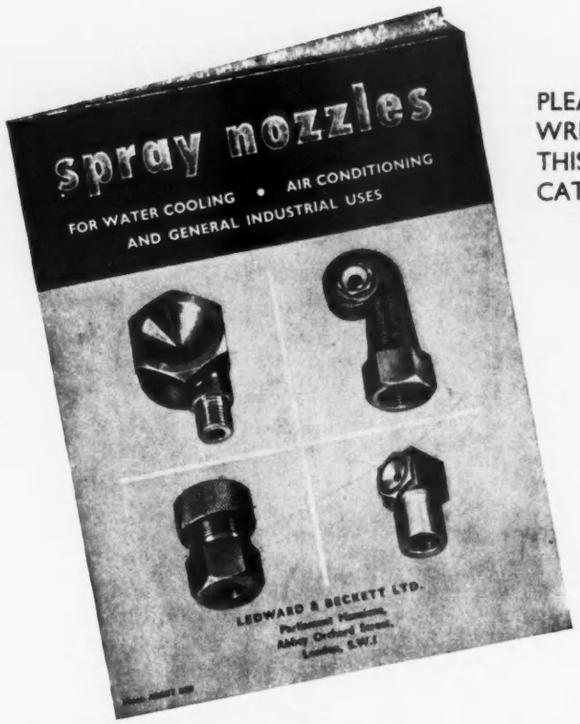


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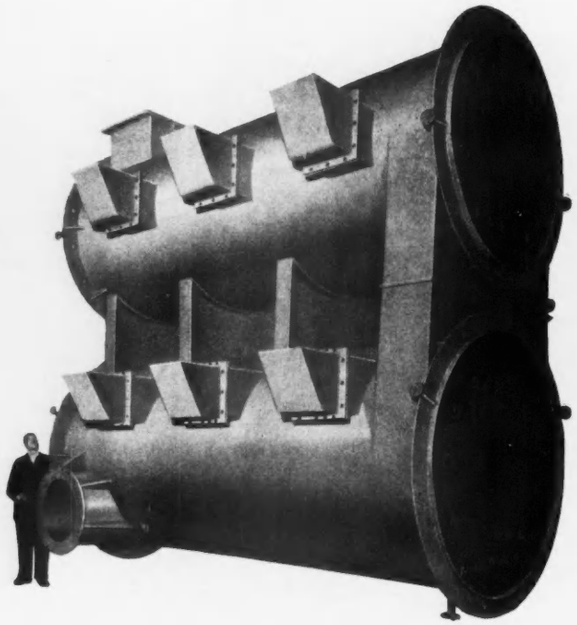

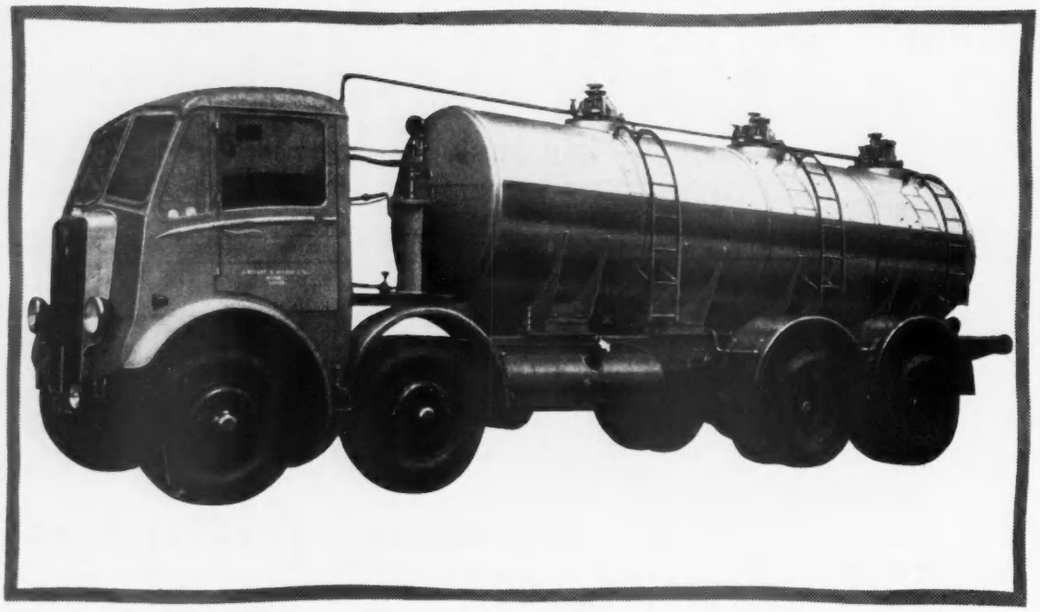

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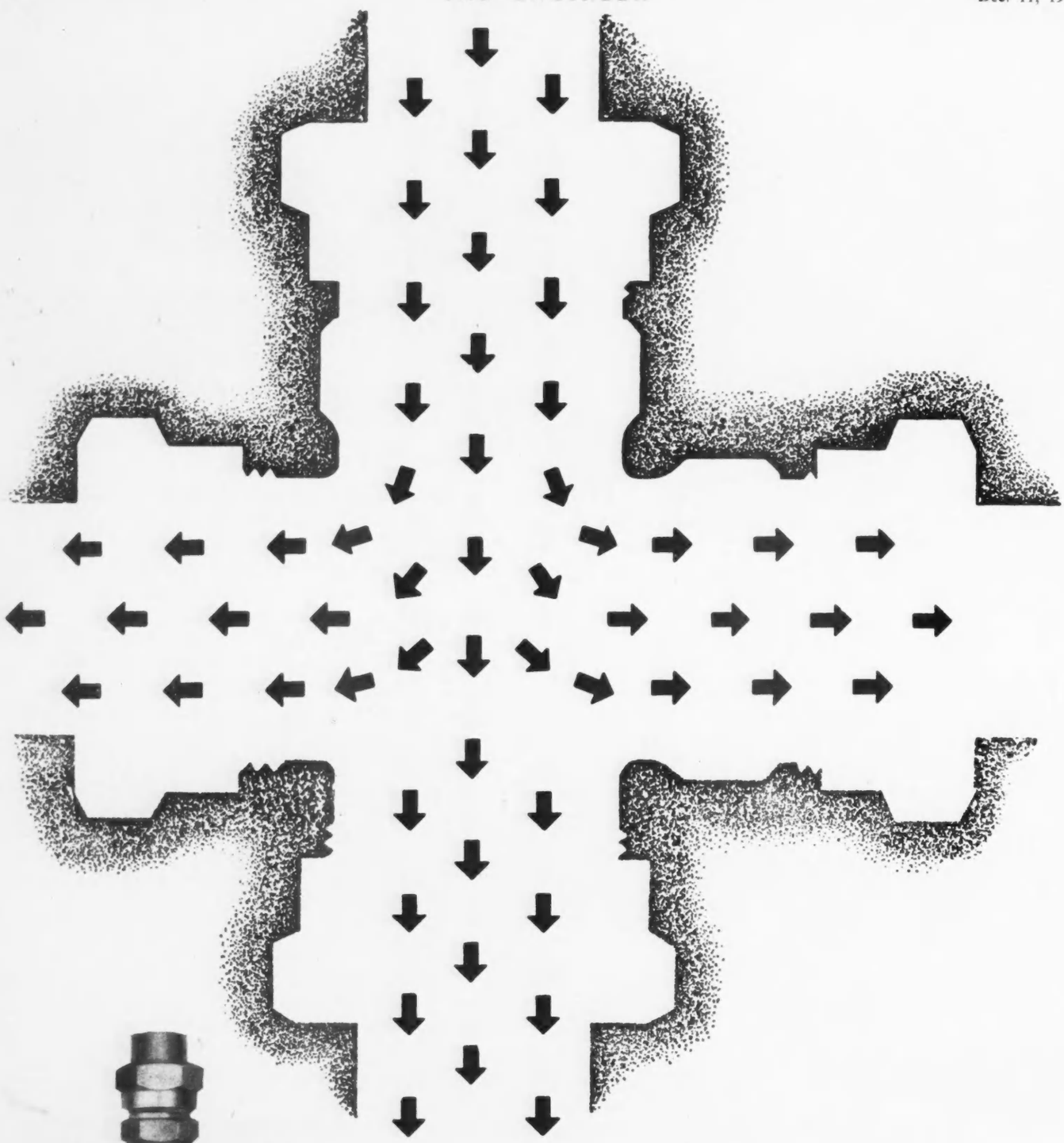

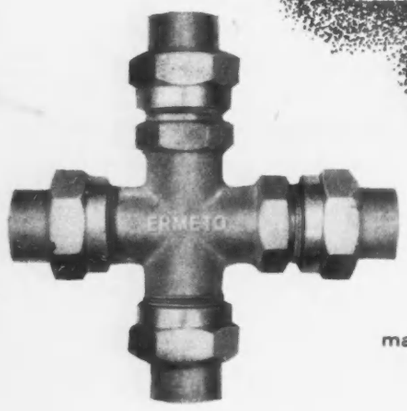


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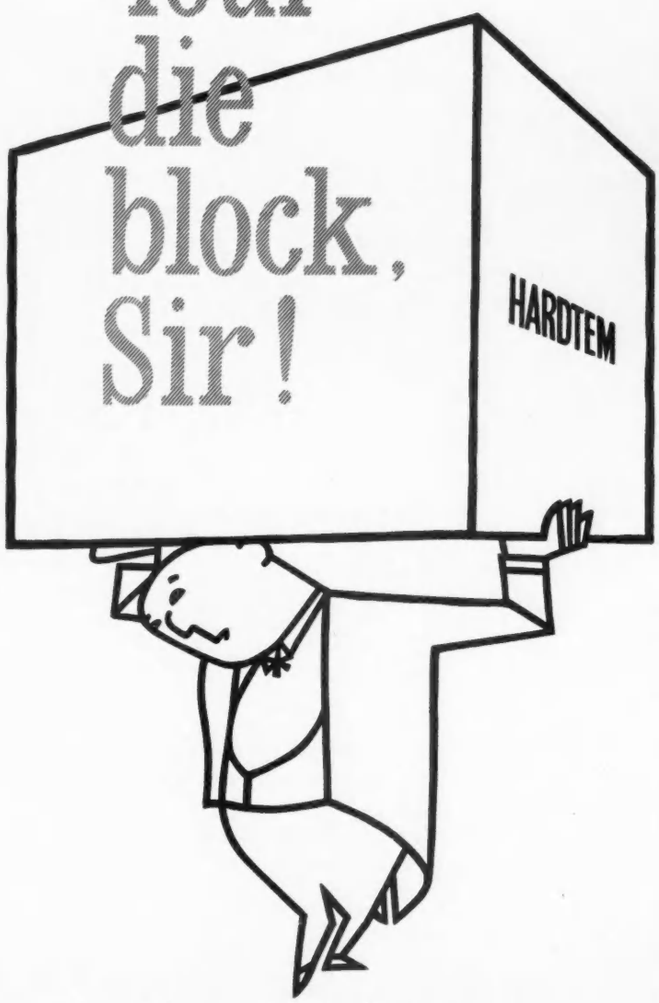


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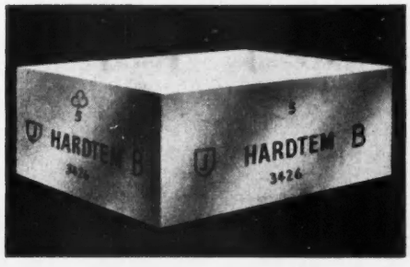


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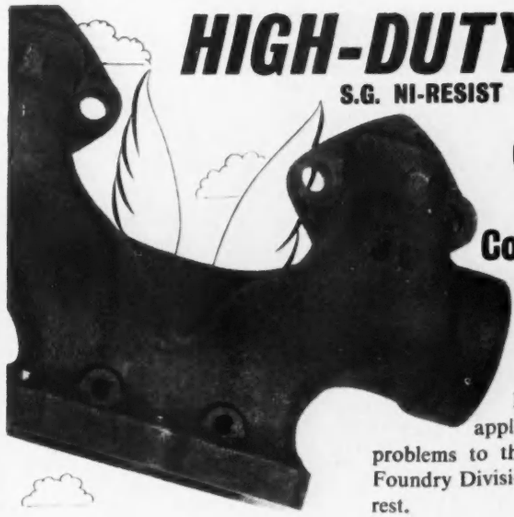

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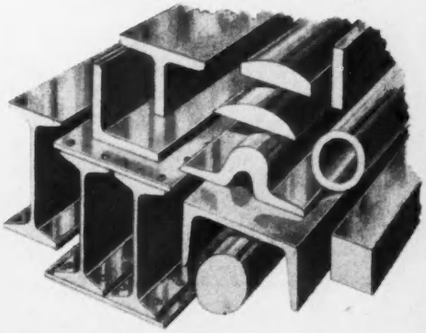

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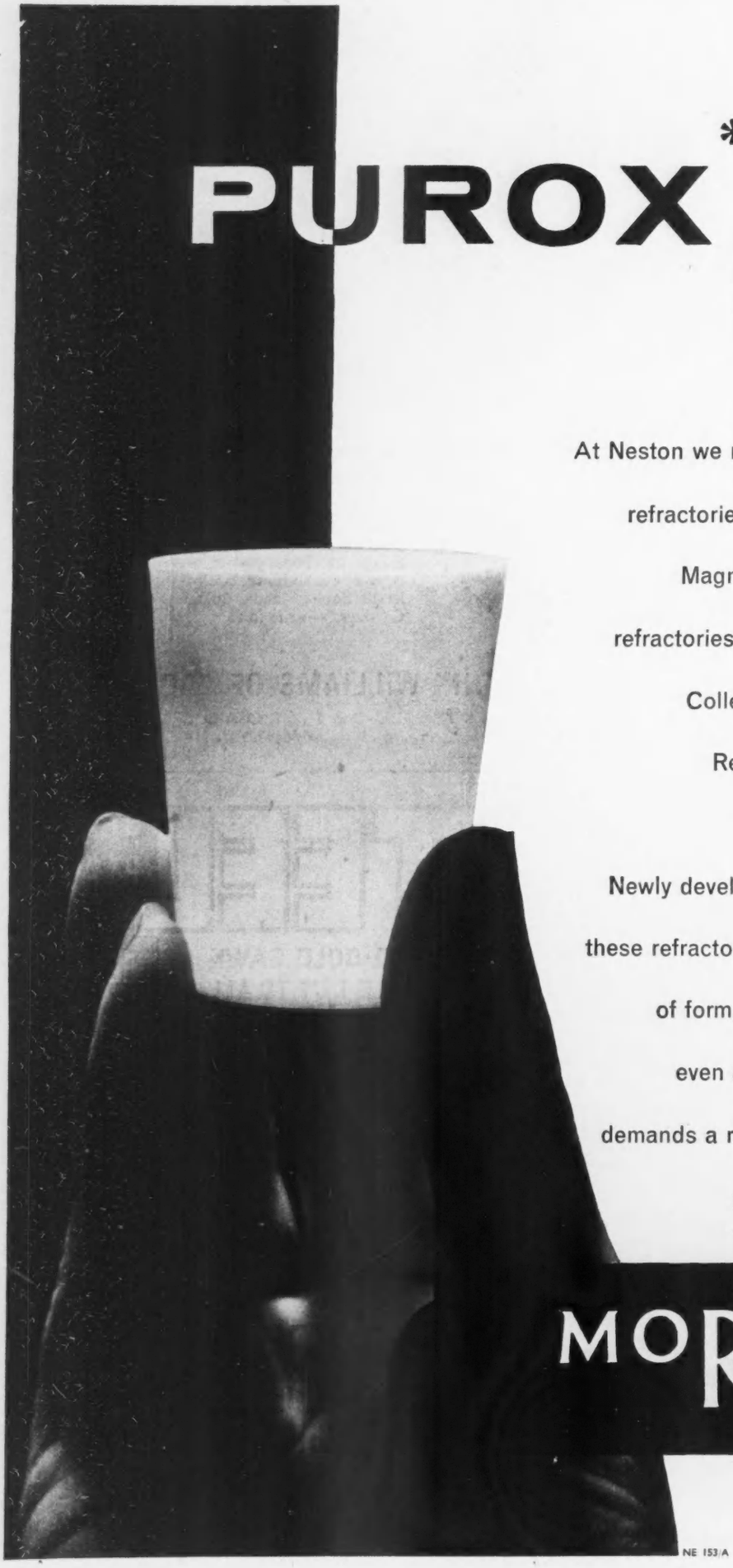

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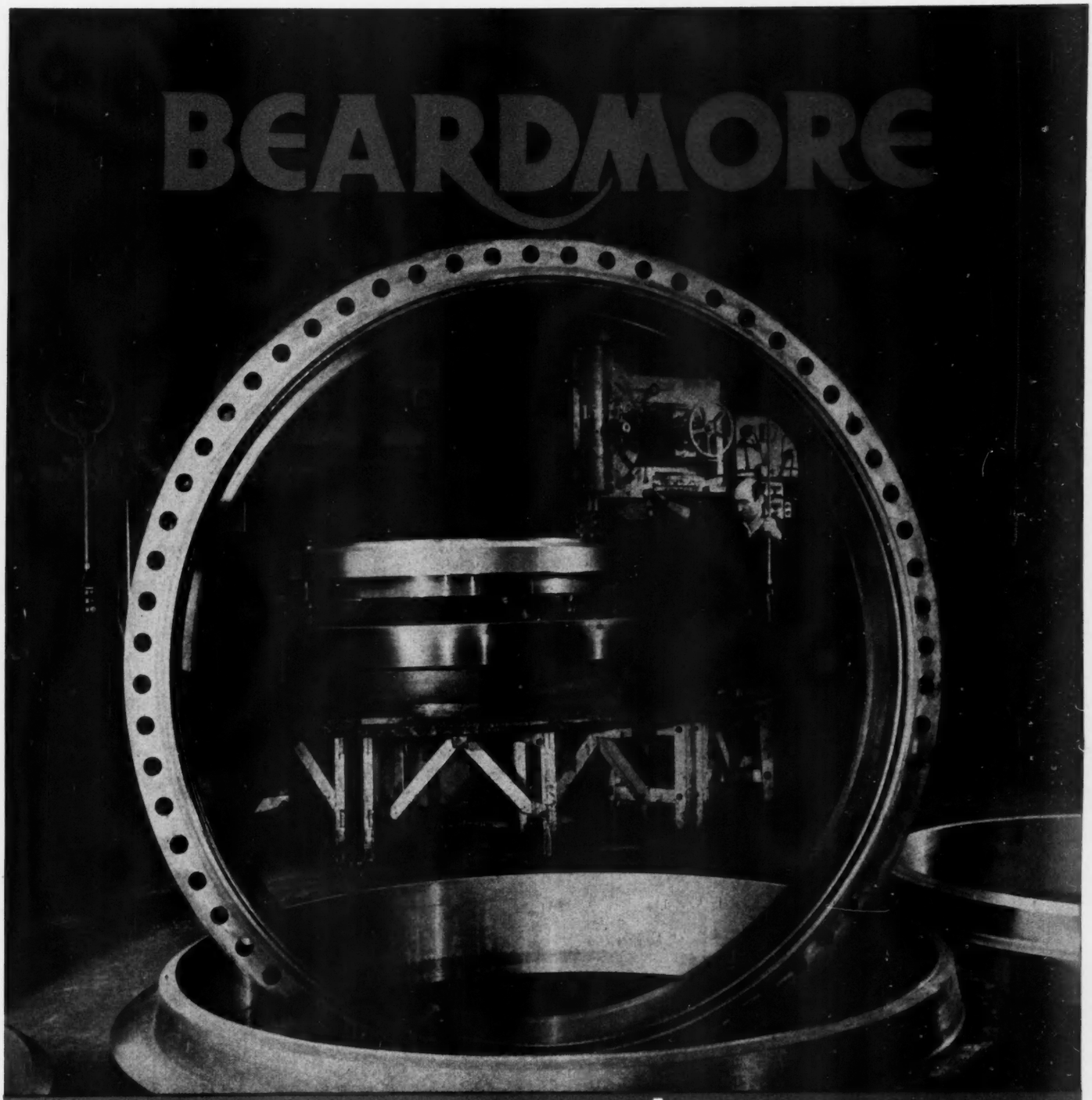


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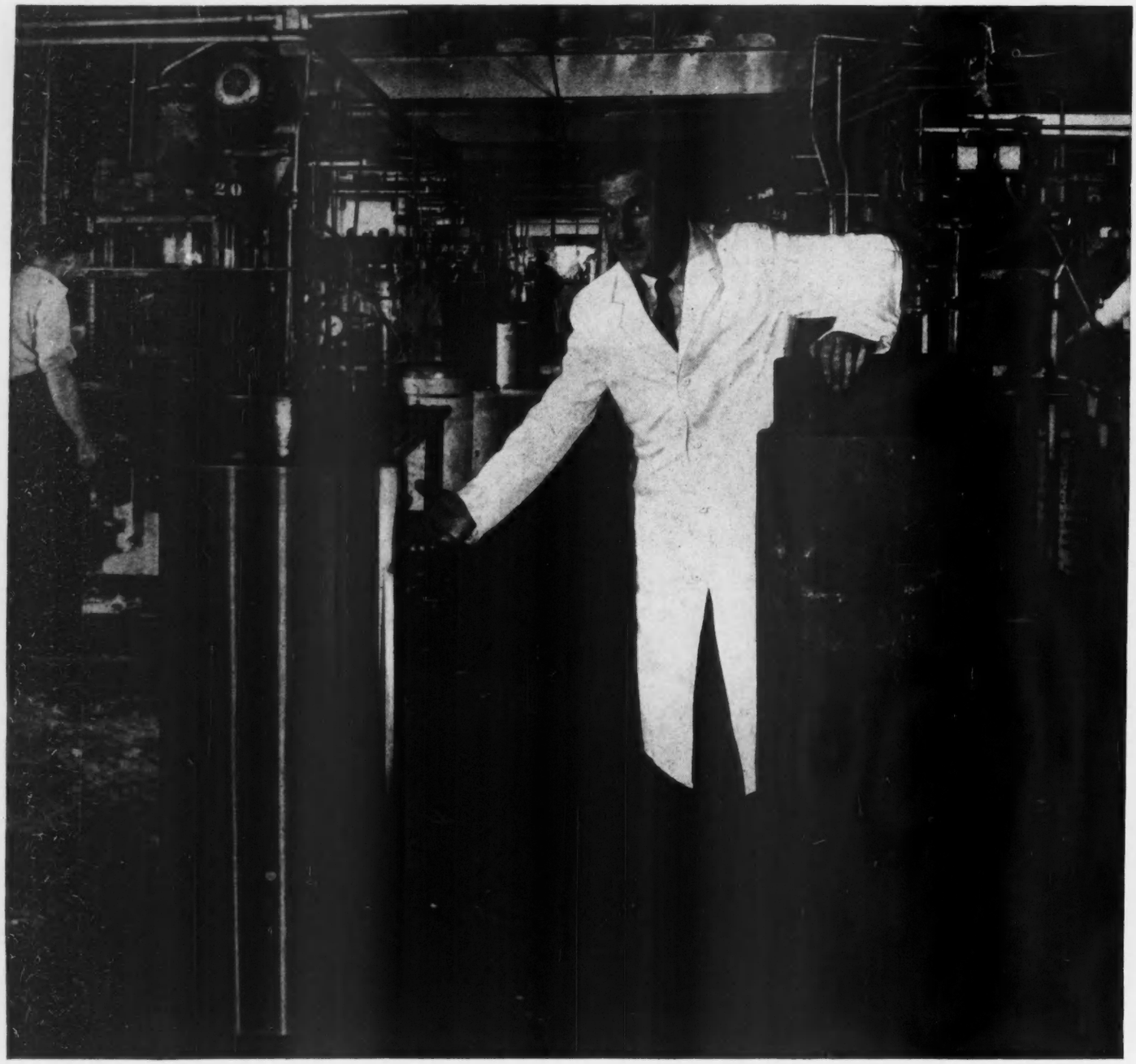

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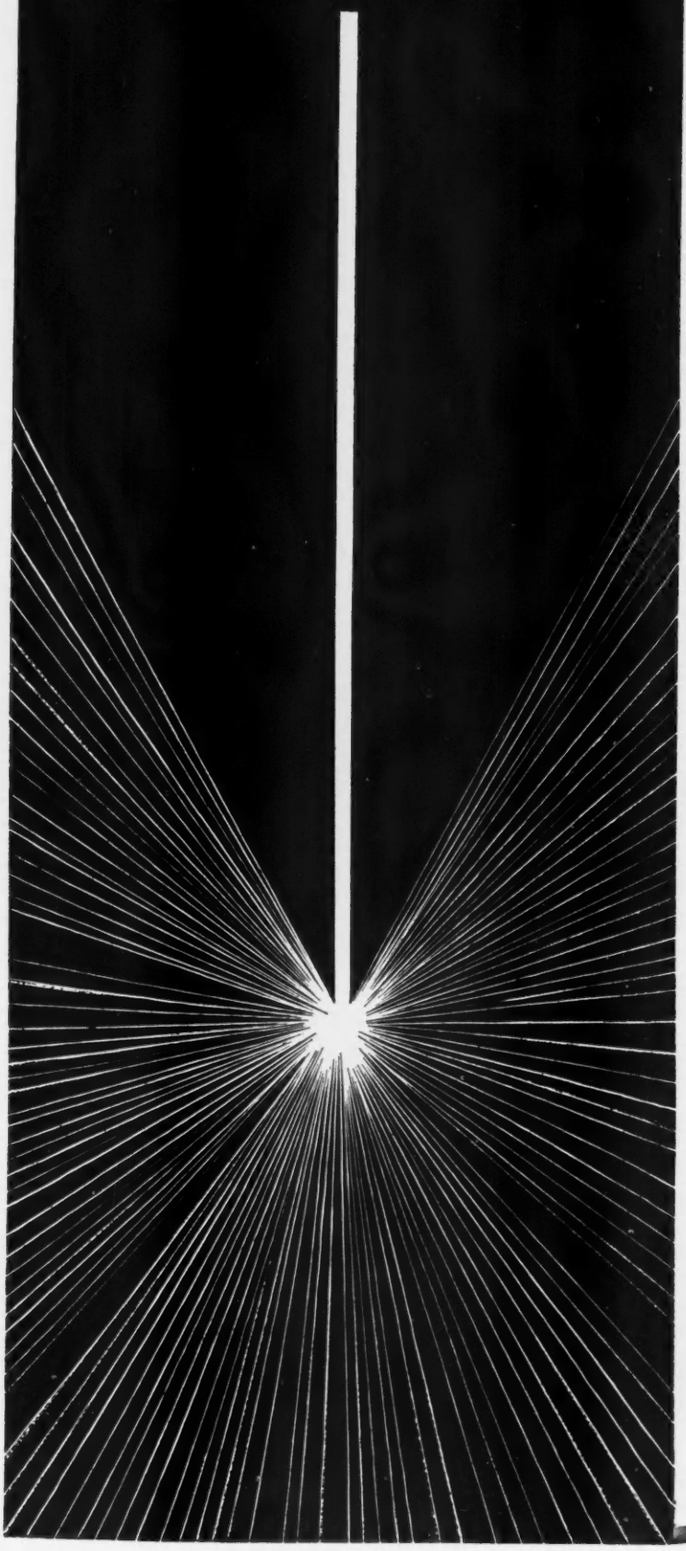

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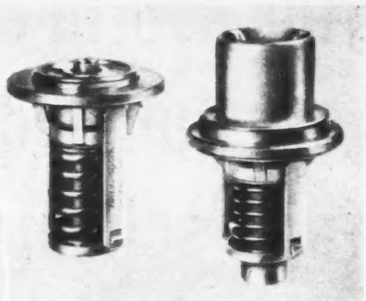

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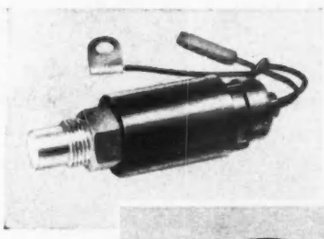

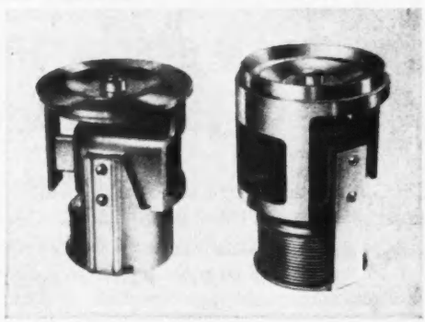

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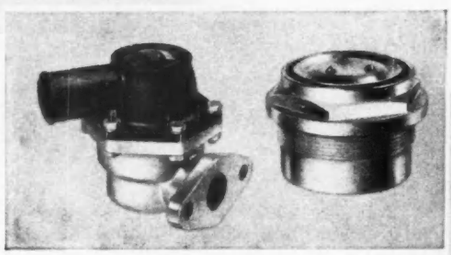

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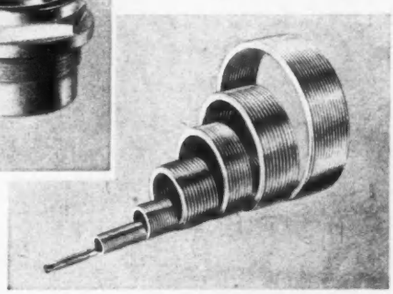

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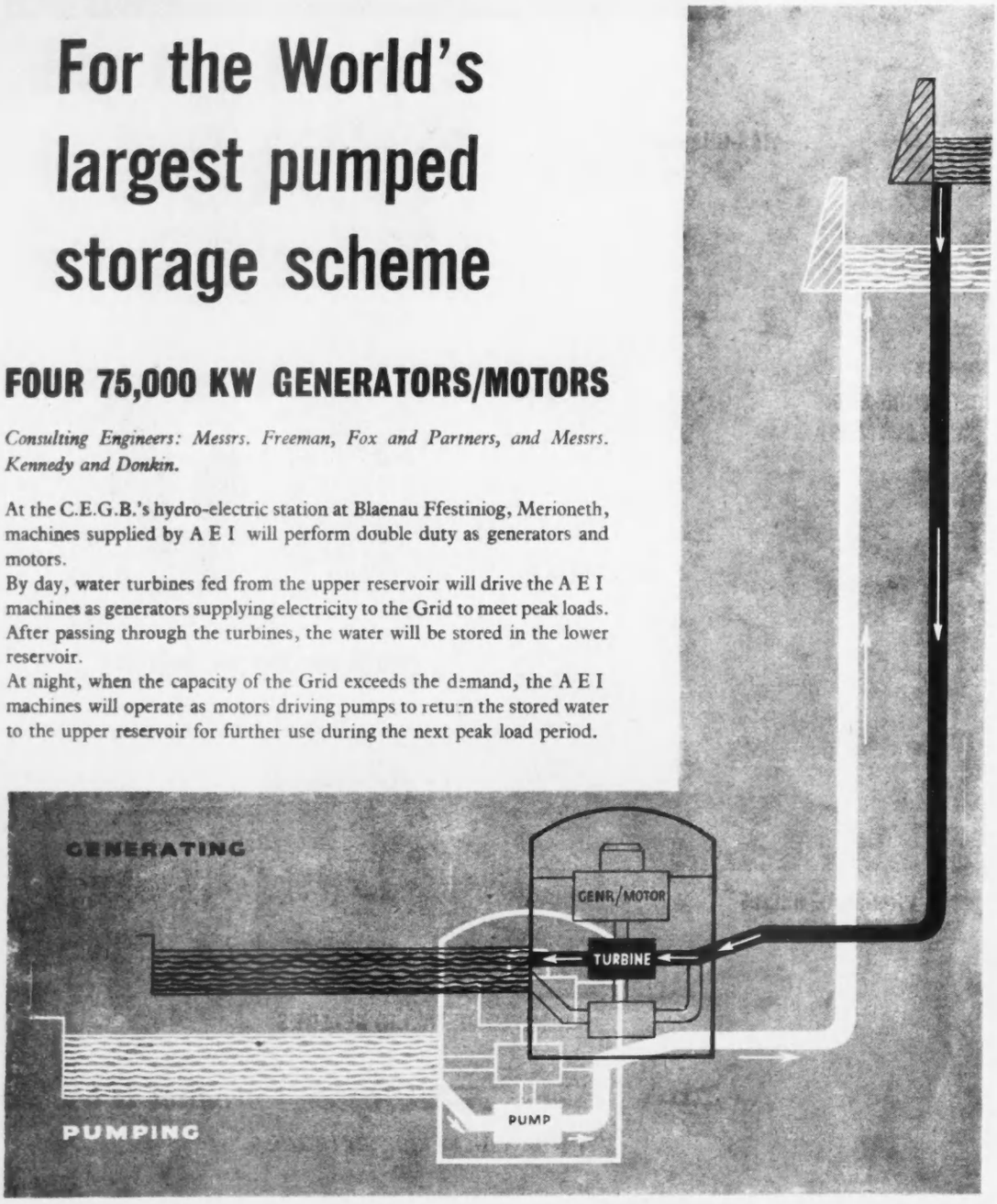


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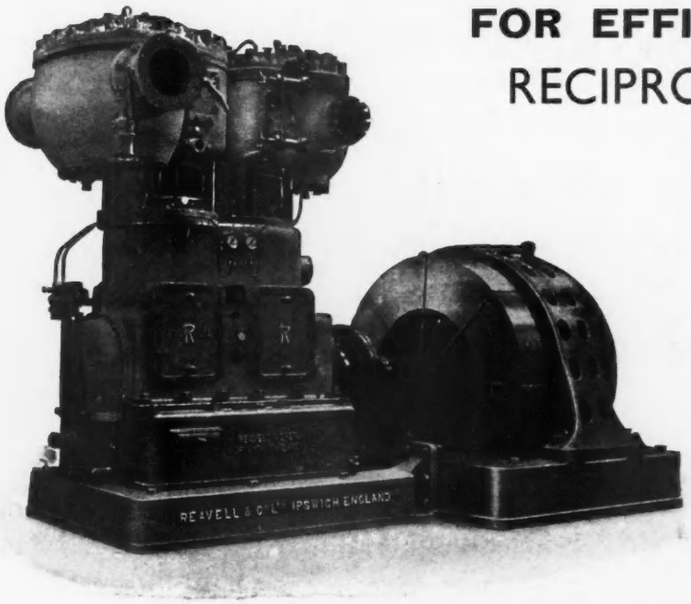


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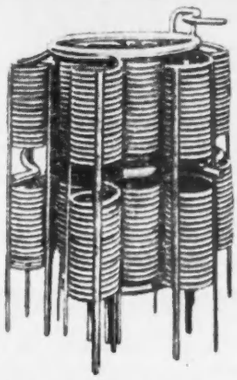

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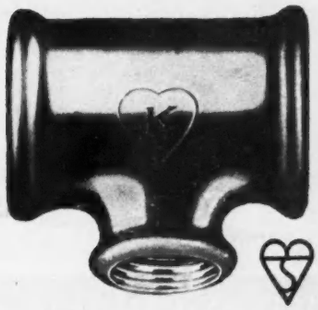

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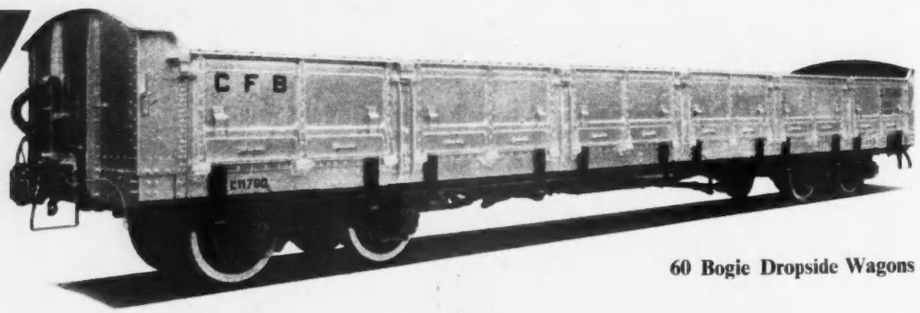


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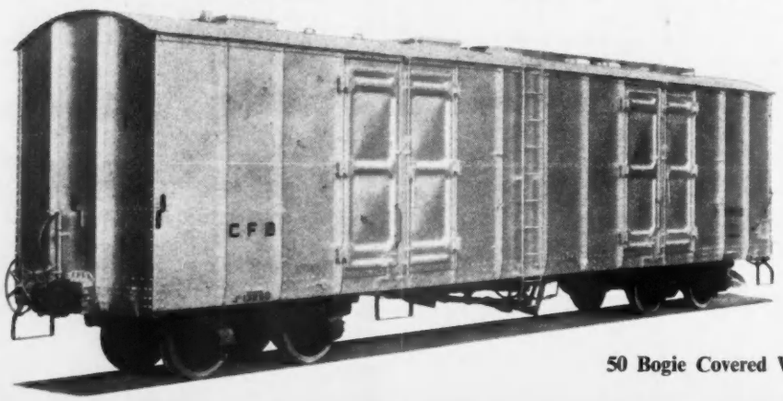


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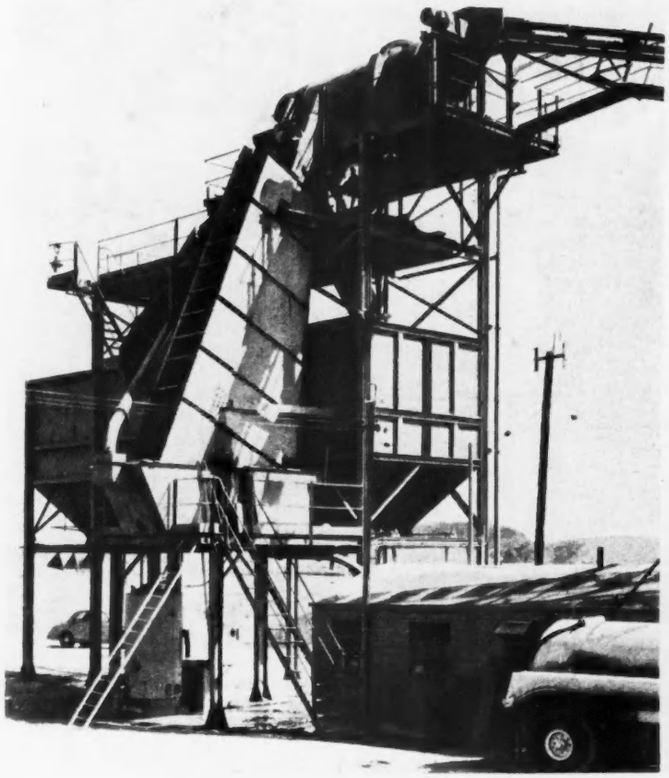

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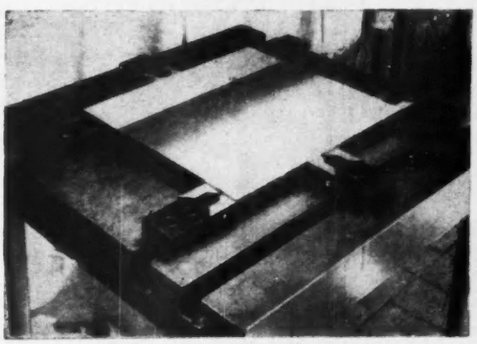

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| 2 | 60/1 | 2 12 0 | 60/2 | 3 3 0 | 3¾ | 2 | ⅝ | ⅝ | 2 |
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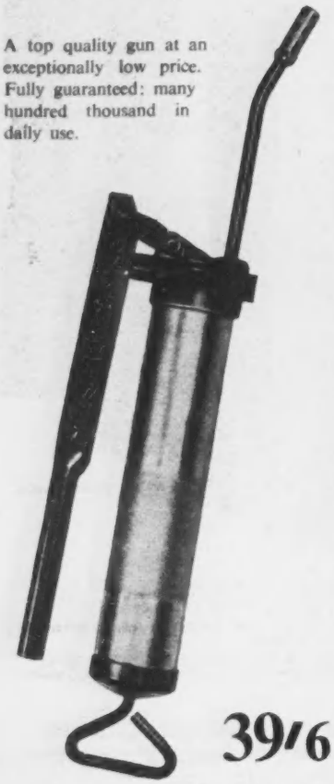

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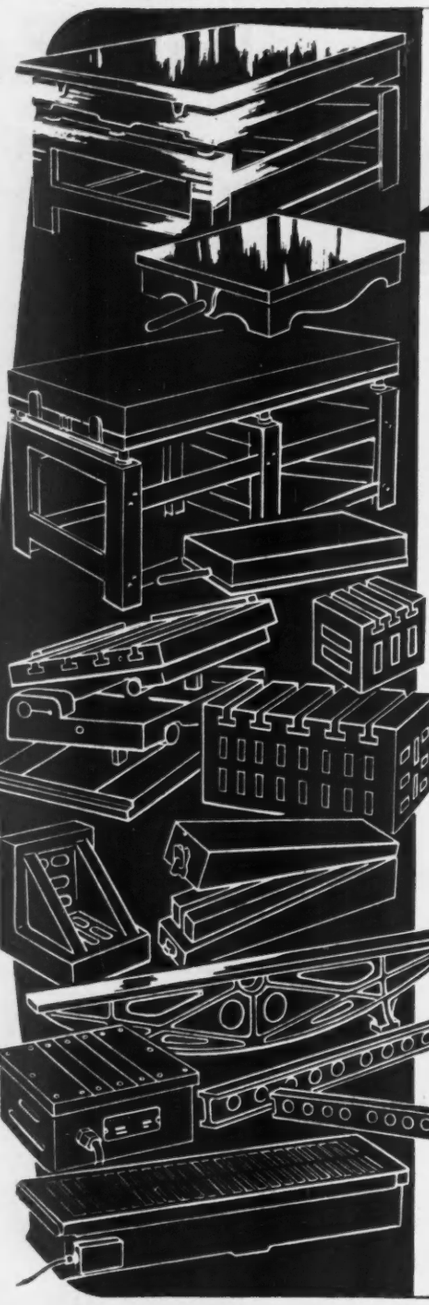

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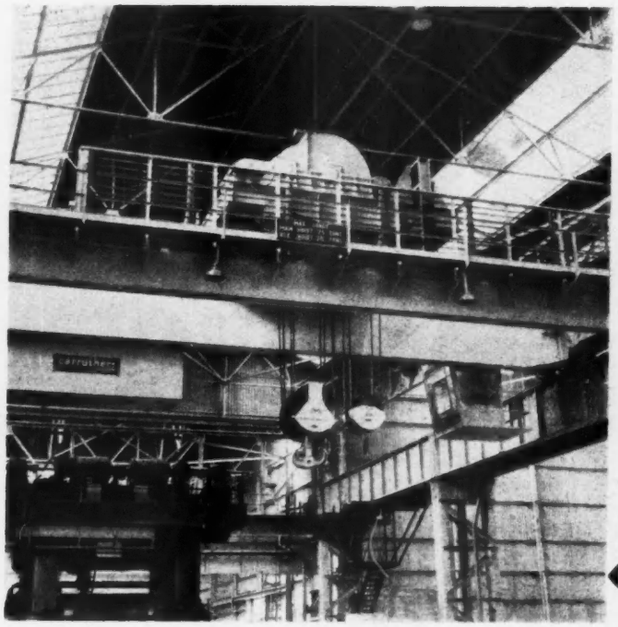

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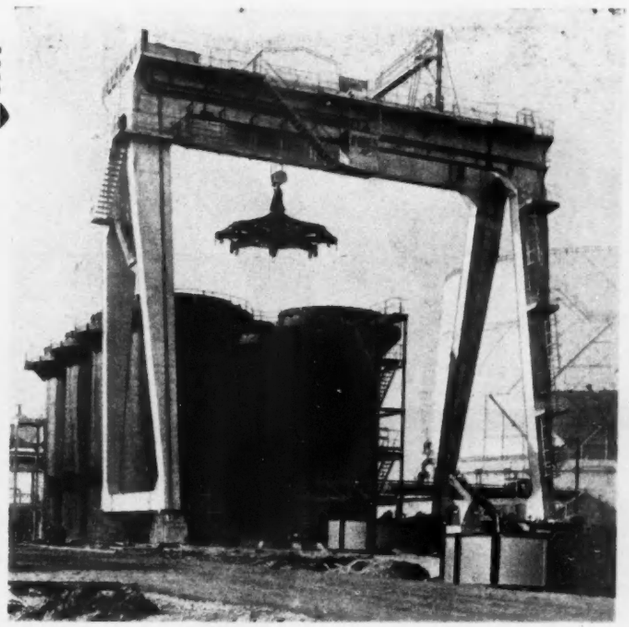

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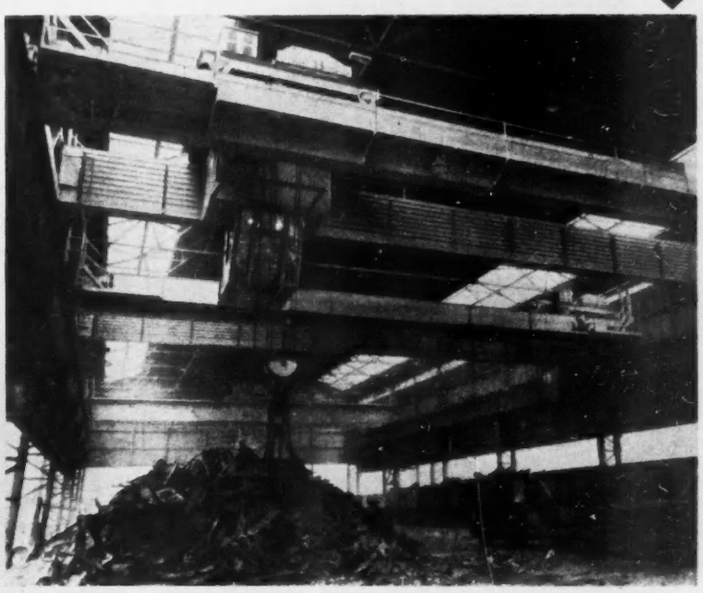

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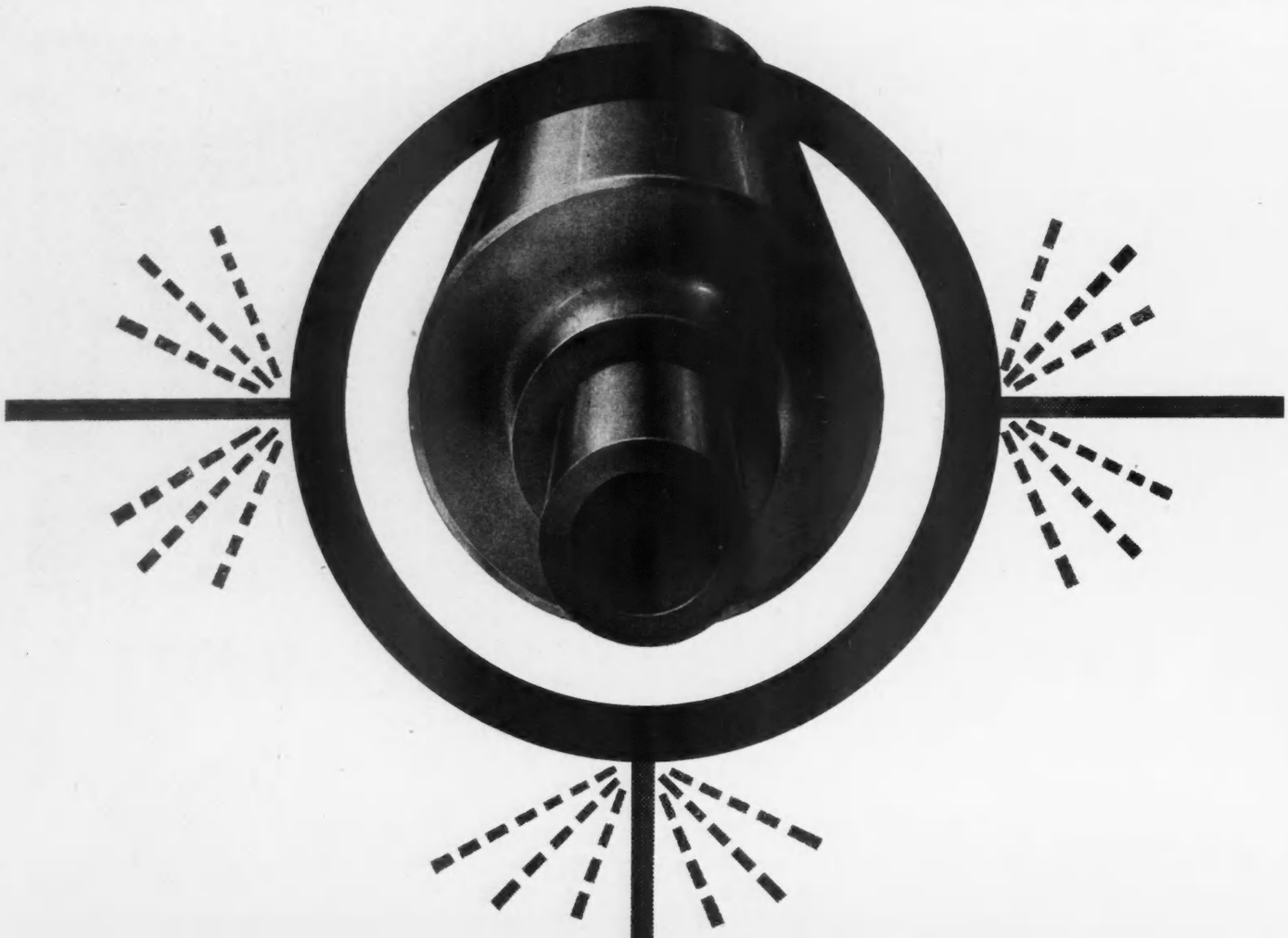

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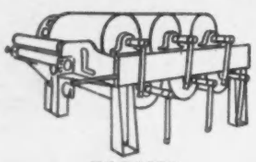

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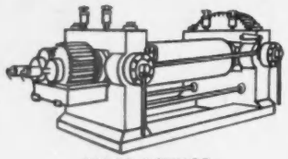

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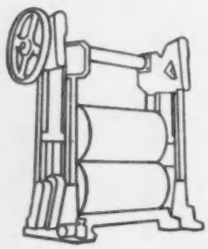

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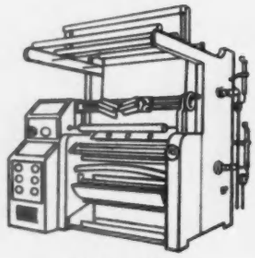

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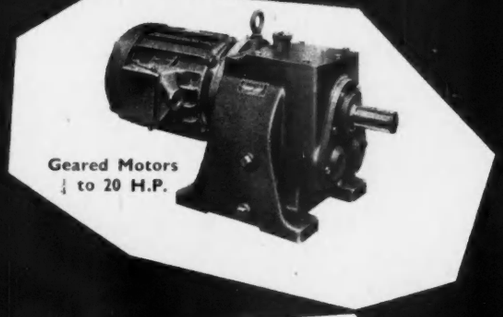

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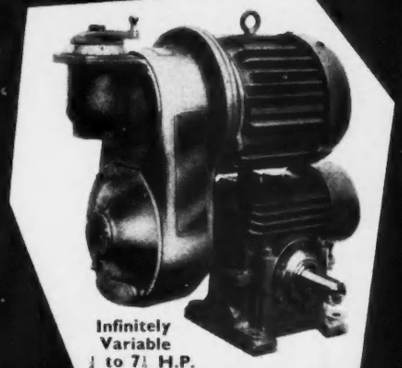

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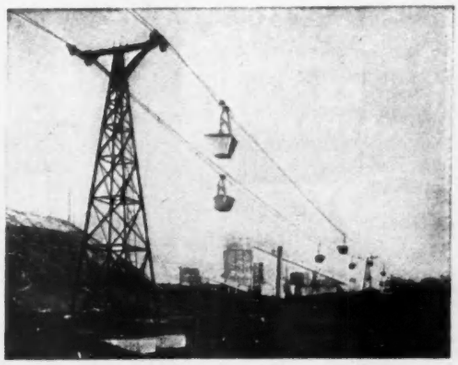

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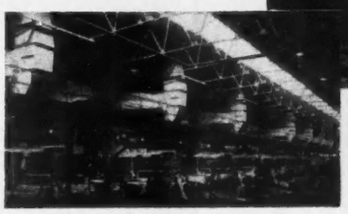

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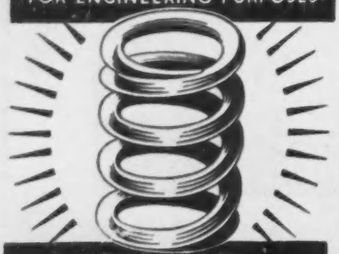

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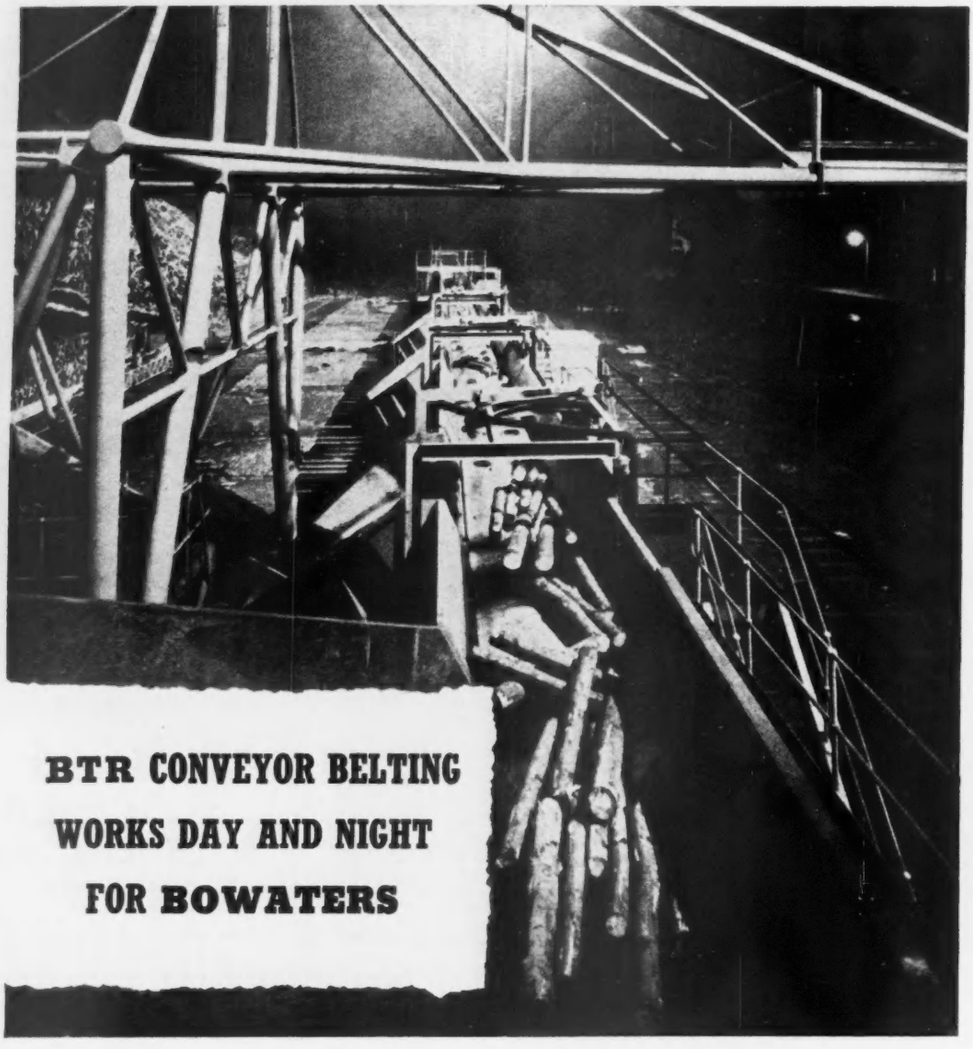

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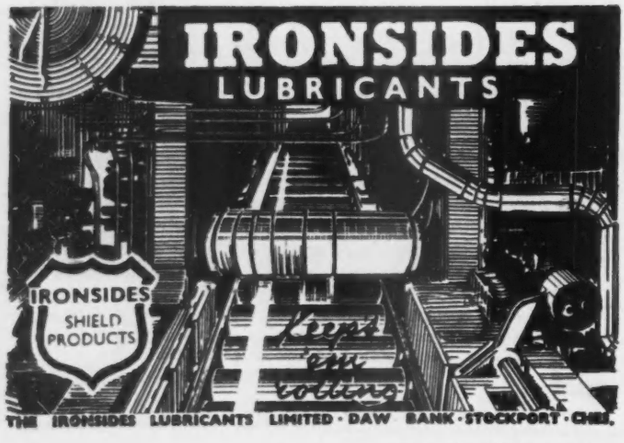


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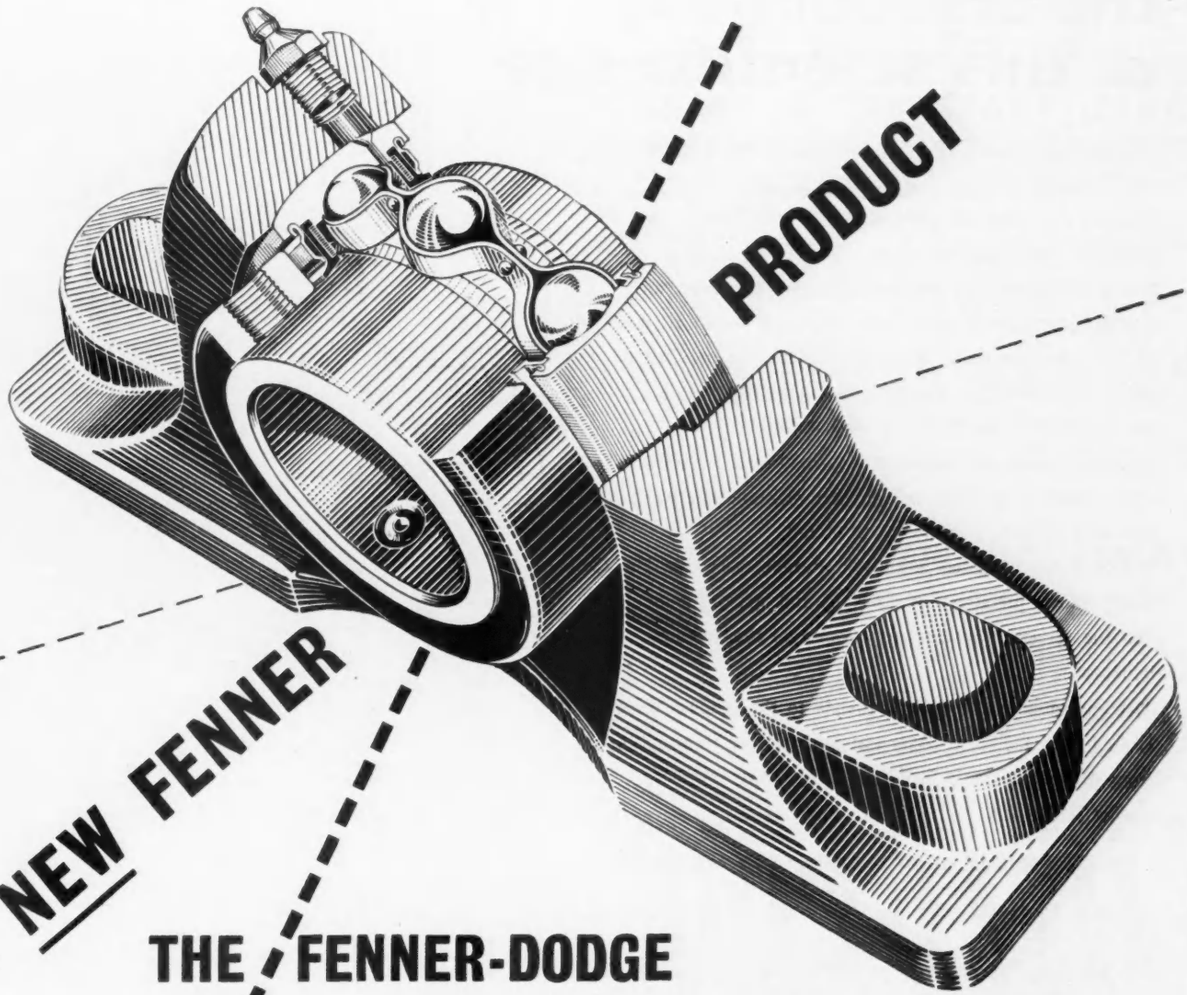

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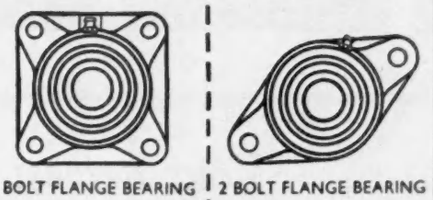

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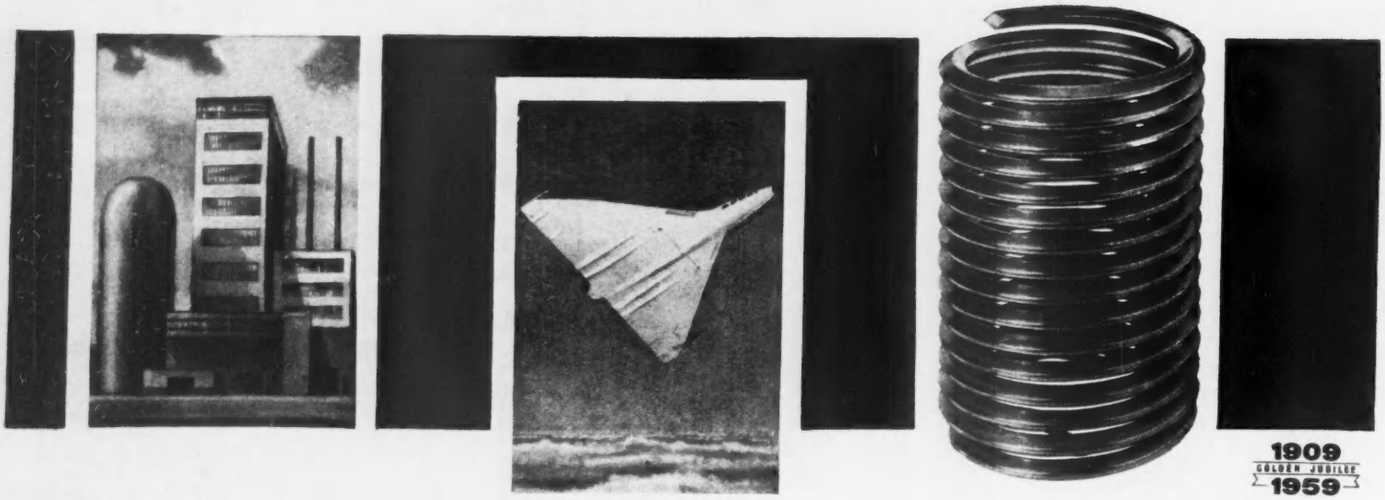


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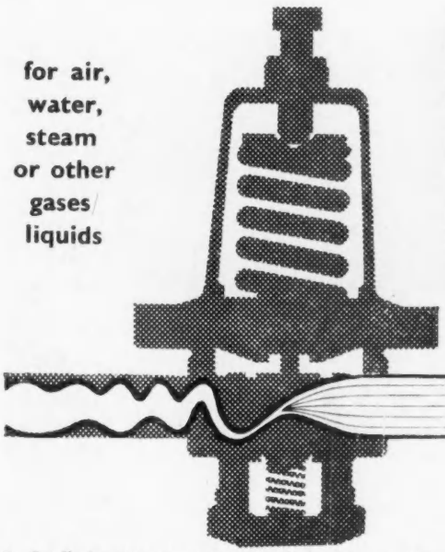

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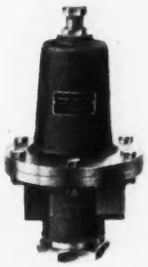

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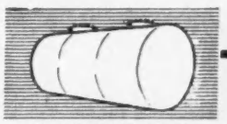

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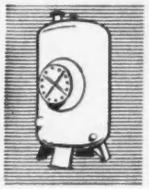

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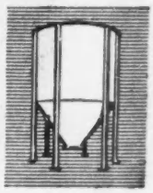

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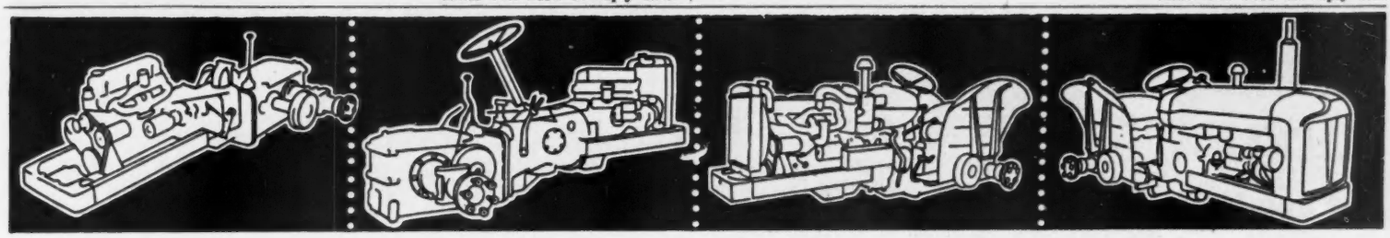

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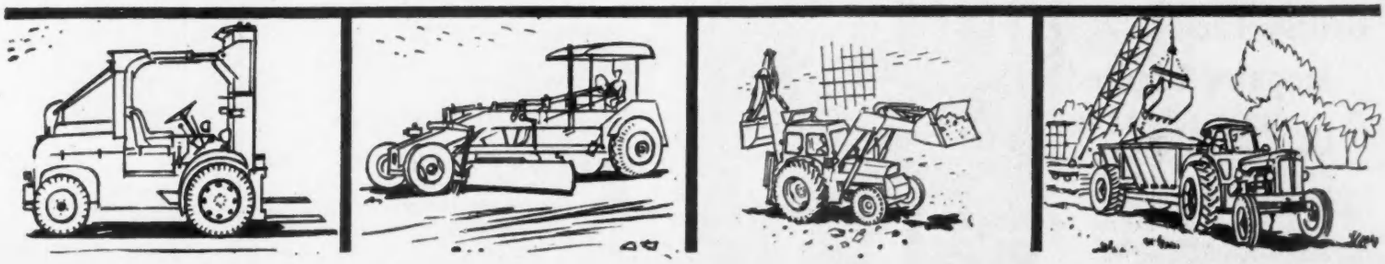

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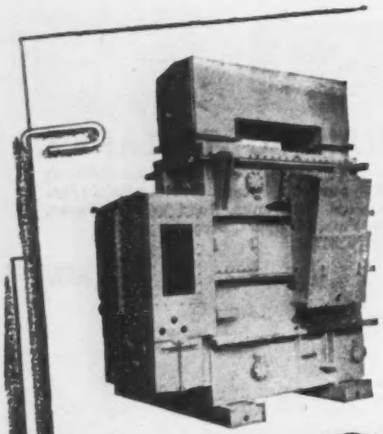

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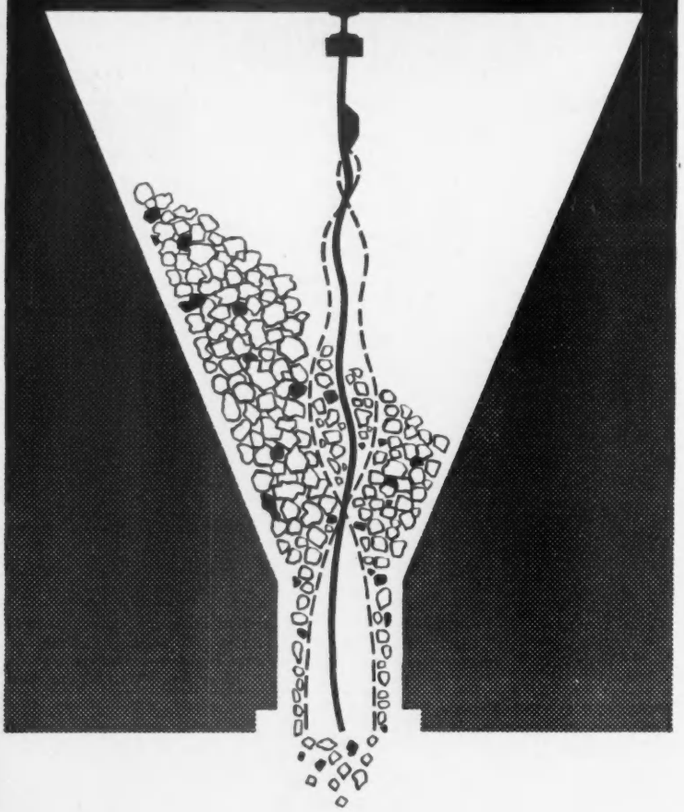

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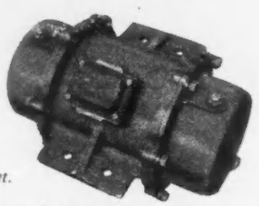

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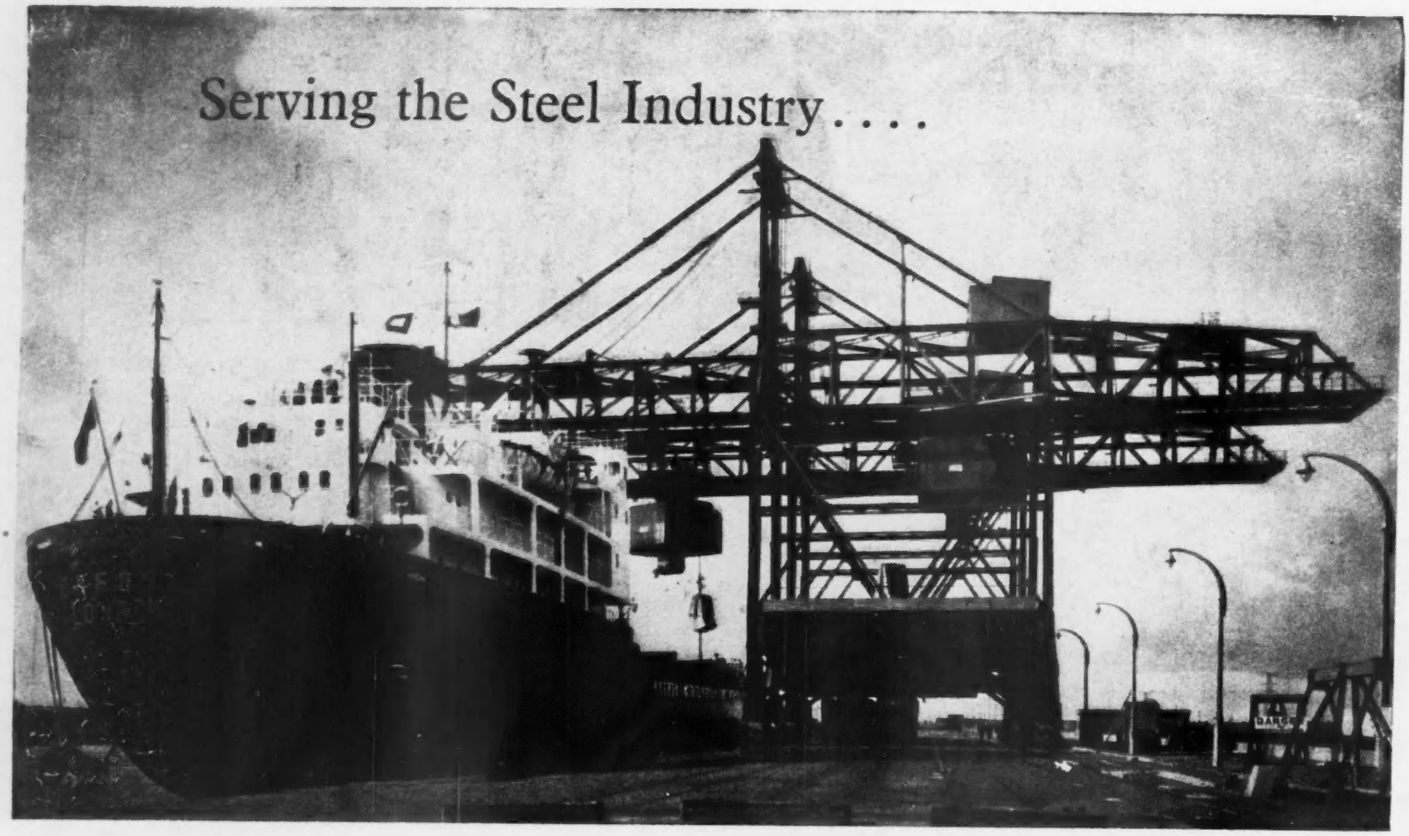

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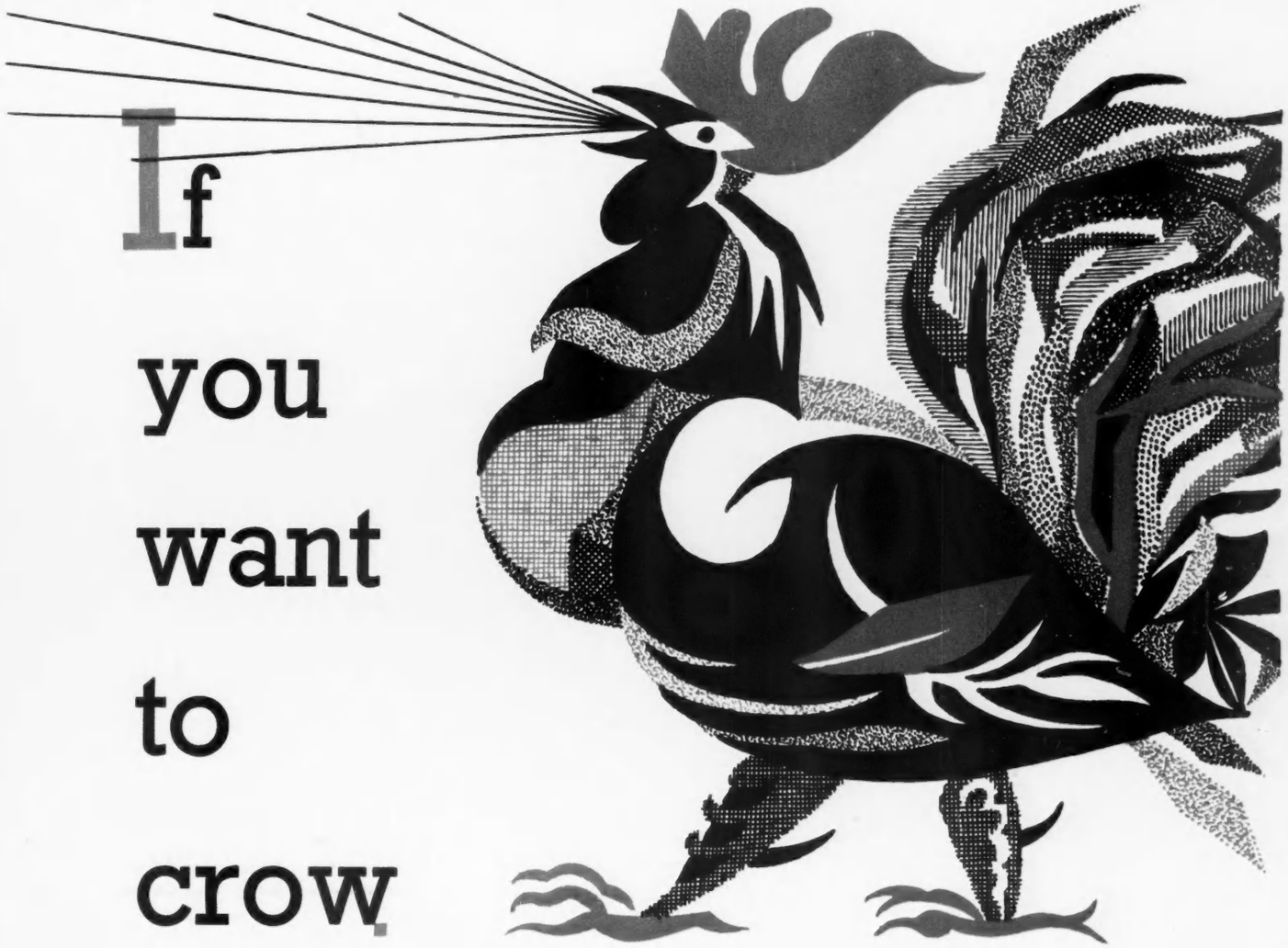

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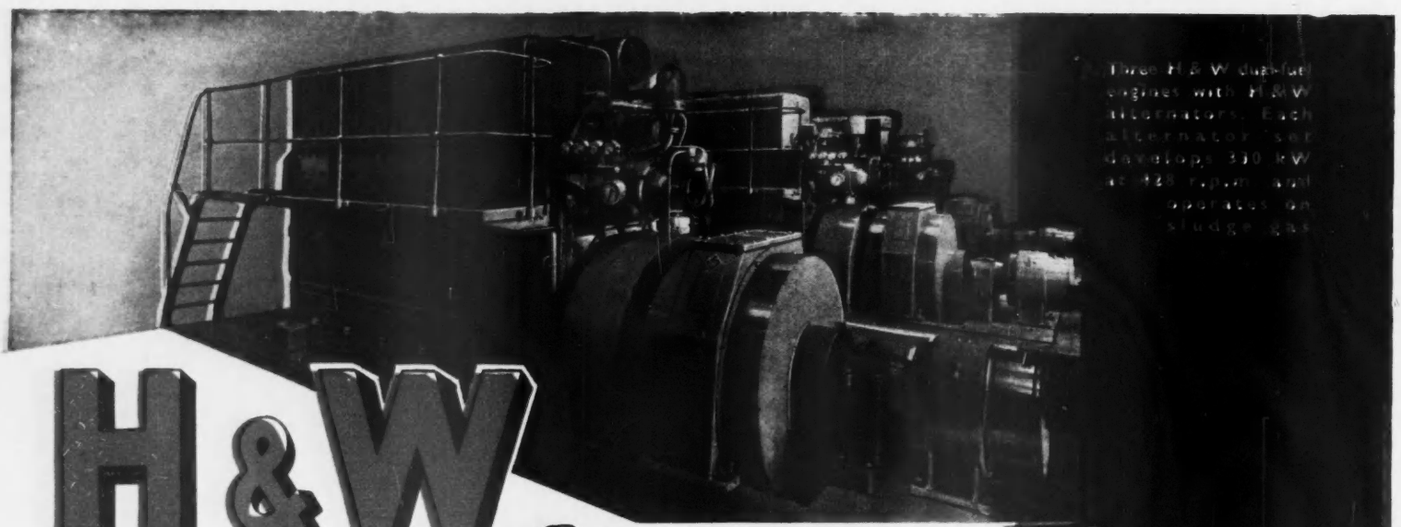

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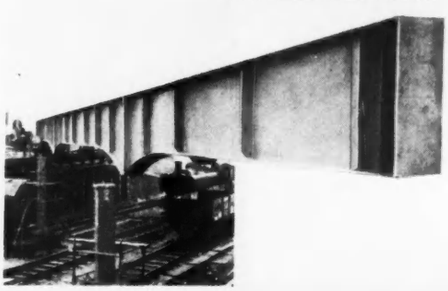

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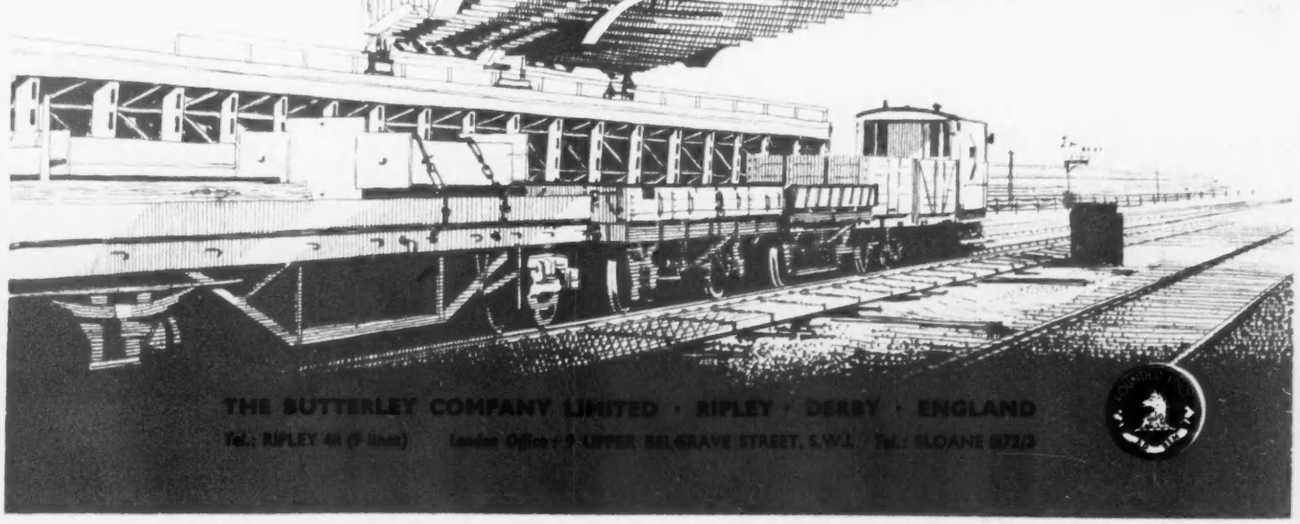

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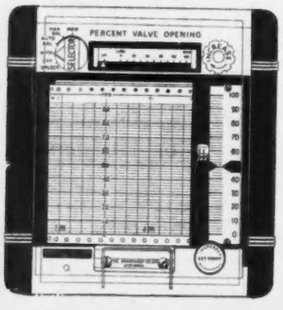


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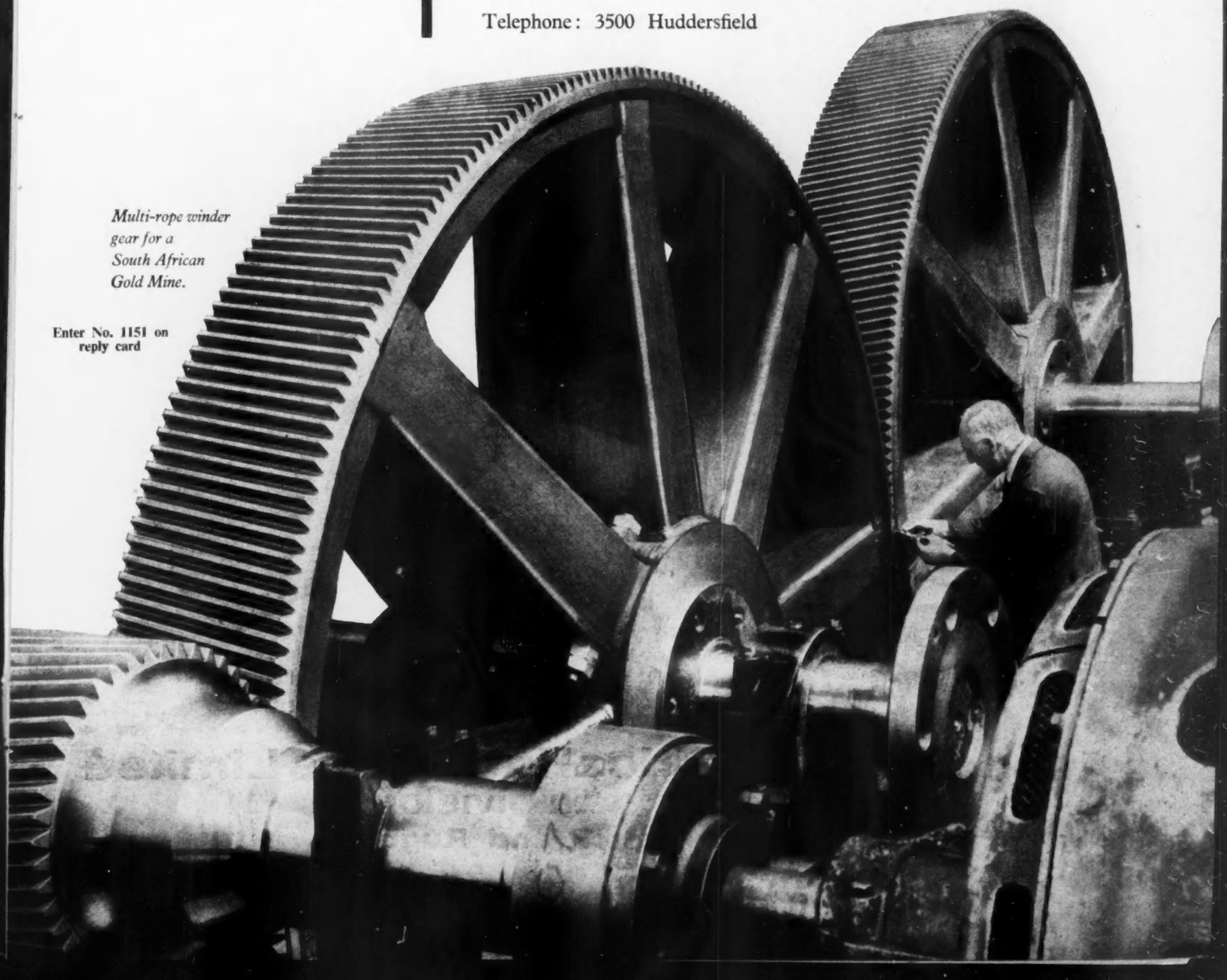

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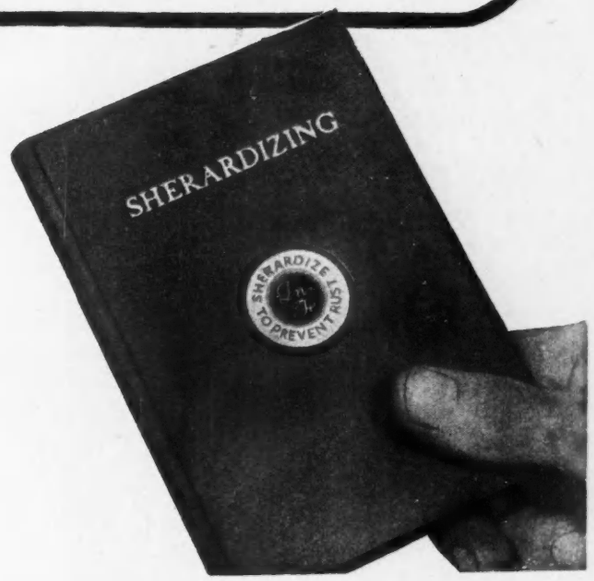


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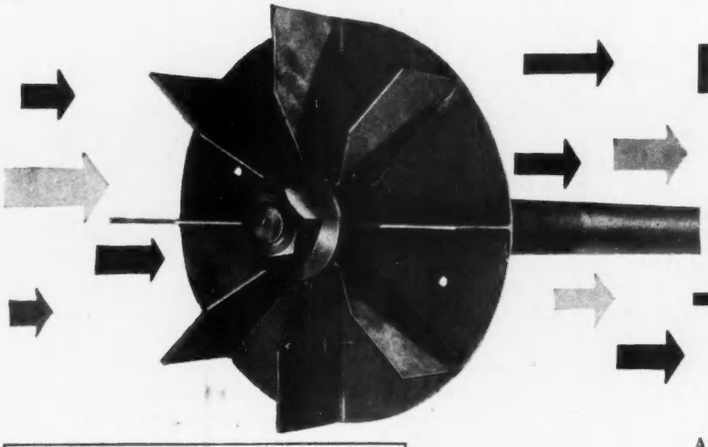

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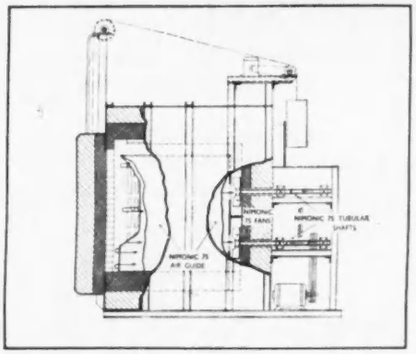


*In addition to the forced-circulation fans and drive shafts, Nimonic 75 is used for the air-guide furnace liner which directs circulating air over the heating elements.*

*Diagram shows forced-circulation system and the Nimonic 75 hollow-fan shafts cooled by compressed air.*

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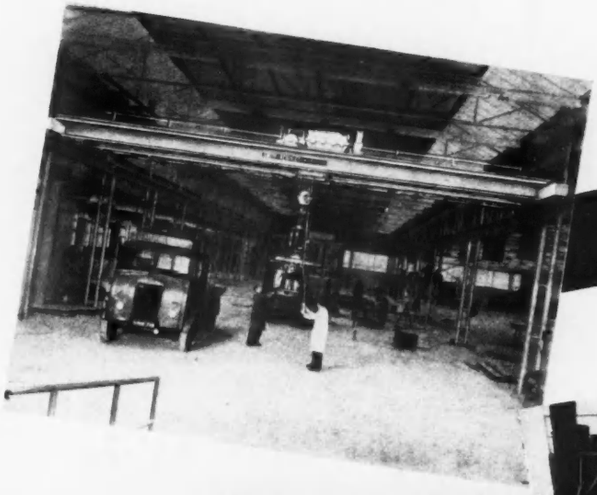

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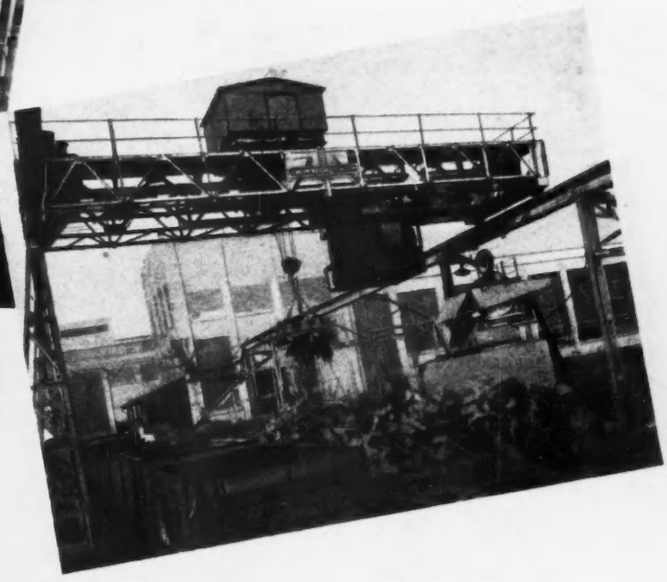

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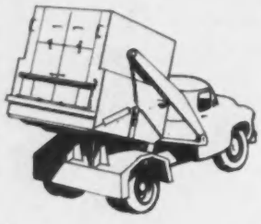
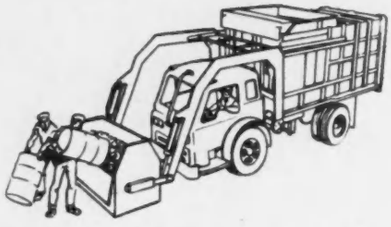
# THE DEMPSTER DUMPSTER SYSTEMS

# the NEW SYSTEM of waste disposal

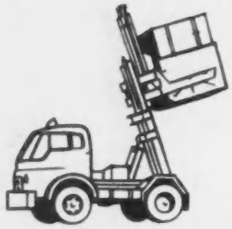


LFW TYPE WITH CONTAINERS IN CARRYING POSITION

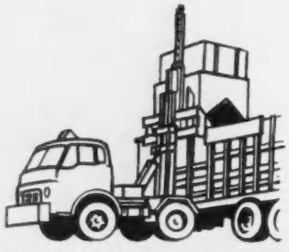


DUMPMASTER CONTAINERS LOADED AT GROUND LEVEL

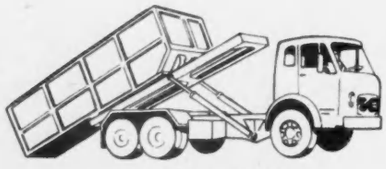
DUMPMASTER CONTENTS EMPTIED INTO COMPACTION BODY



GRD RAISES CONTAINER READY FOR DUMPING



DUMPING FROM A 'DROP BOTTOM' CONTAINER



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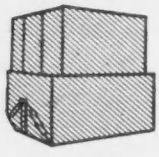
When journeys to outside tips are involved, the "Dumpmaster" range of self-loading, compaction bodied vehicles can lift and empty into their own bodies, containers of up to 6 cu. yards capacity and compress the material in a ratio of up to 3 : 1.

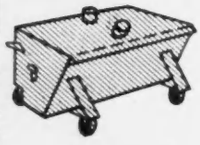
For large scale bulk collection and movement, the Dempster "Dinosaur" is capable of picking up or setting down, off-loading onto raised wharf or tipping to empty, bodies of up to 40 cu. yards capacity.

Dempster systems are adaptable to meet every waste disposal problem and are suitable for many process materials handling applications. If you have a waste handling problem or are collecting by conventional methods why not ask for a survey to be made without obligation? Further information on request—films also available by arrangement.

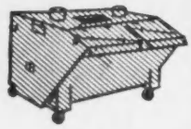
## ALL KINDS OF WASTE CAN BE 'CONTAINERISED'



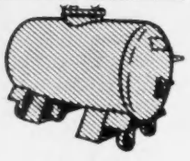
RUBBISH



DUST



SLUDGE



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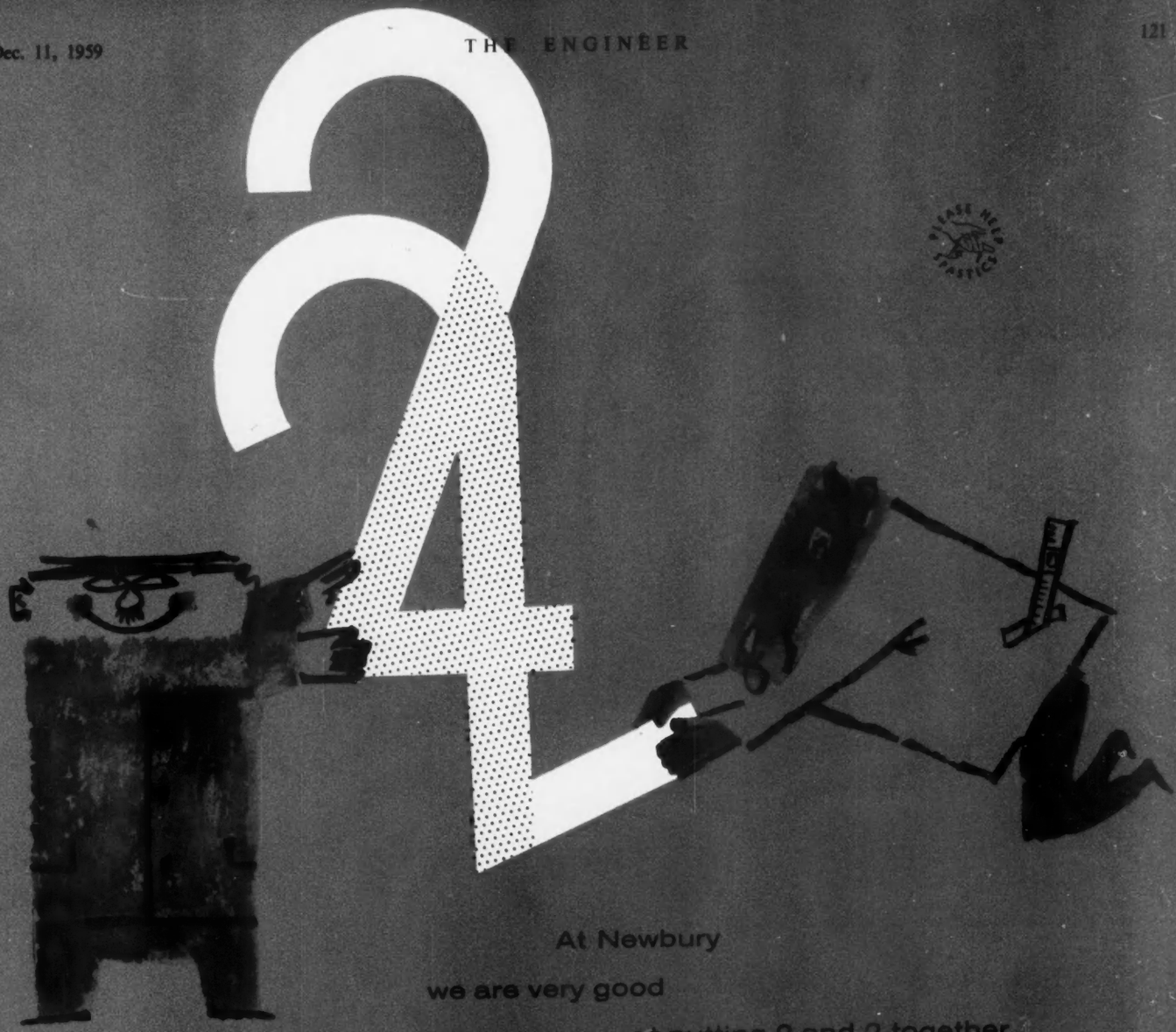


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THE
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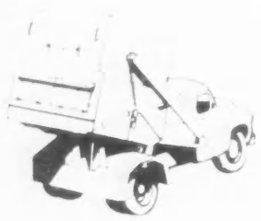

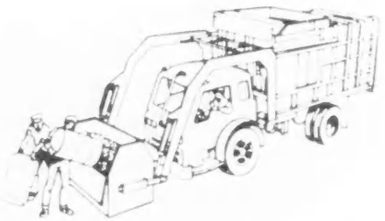

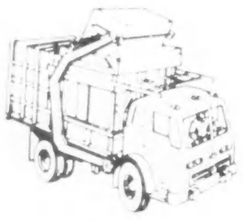

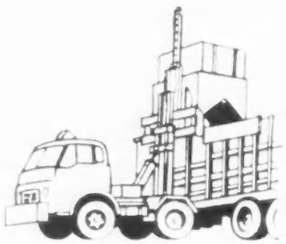

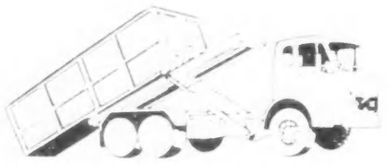

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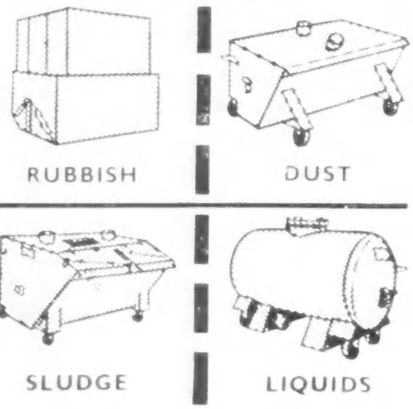


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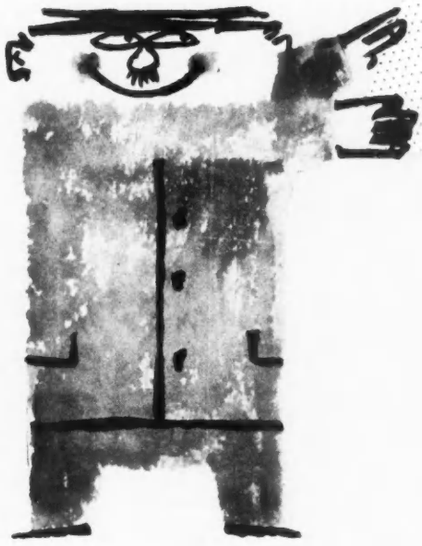

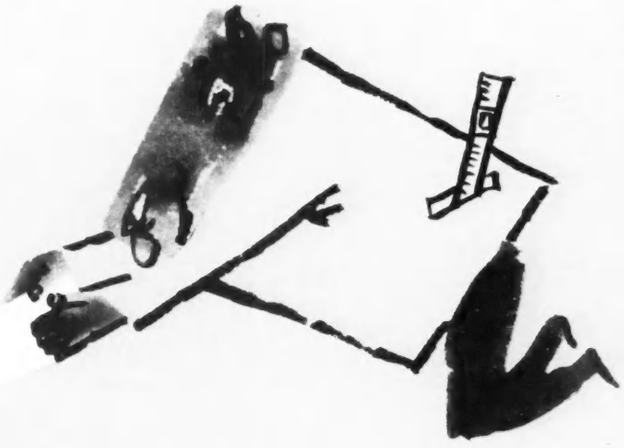

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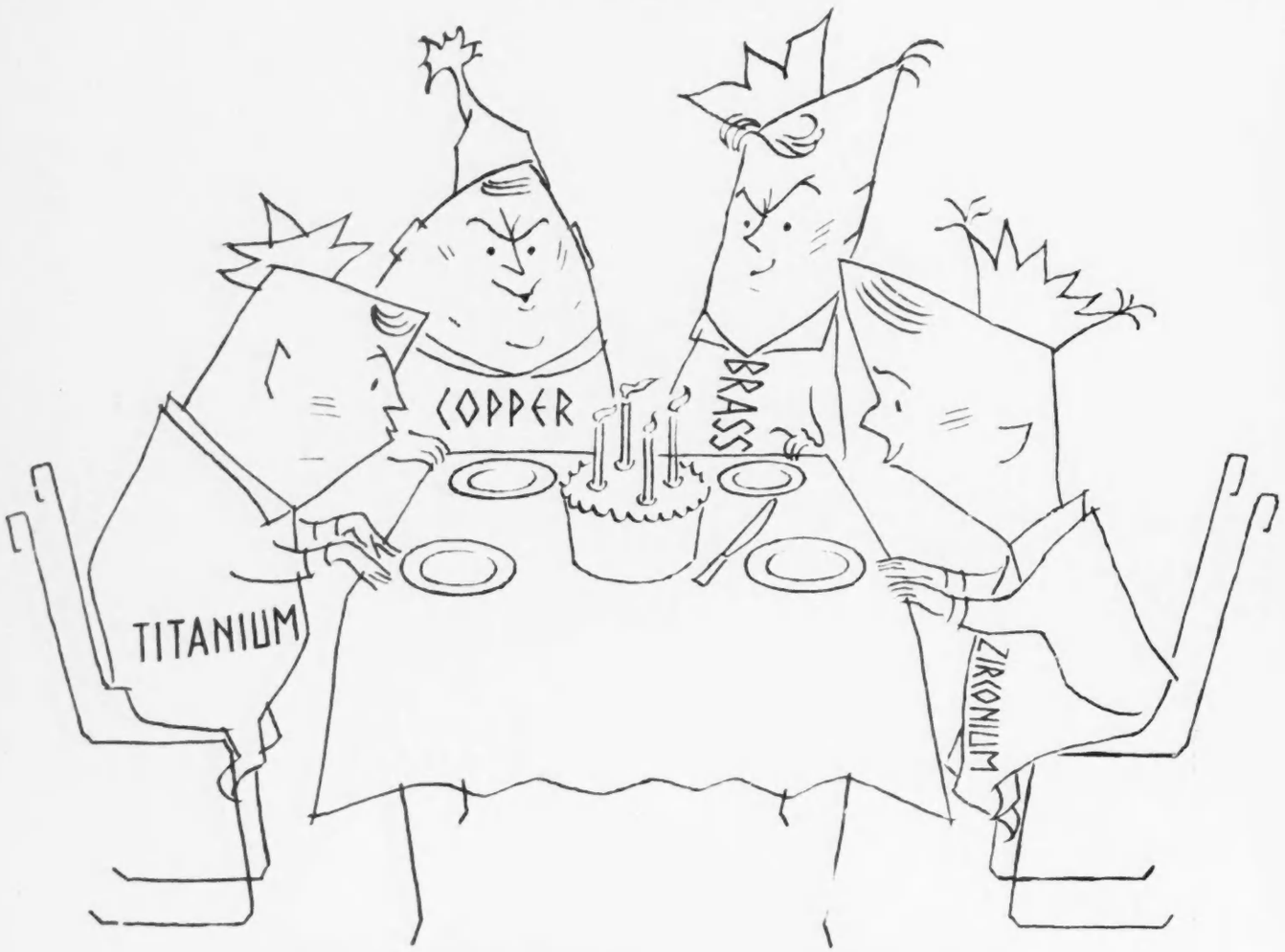


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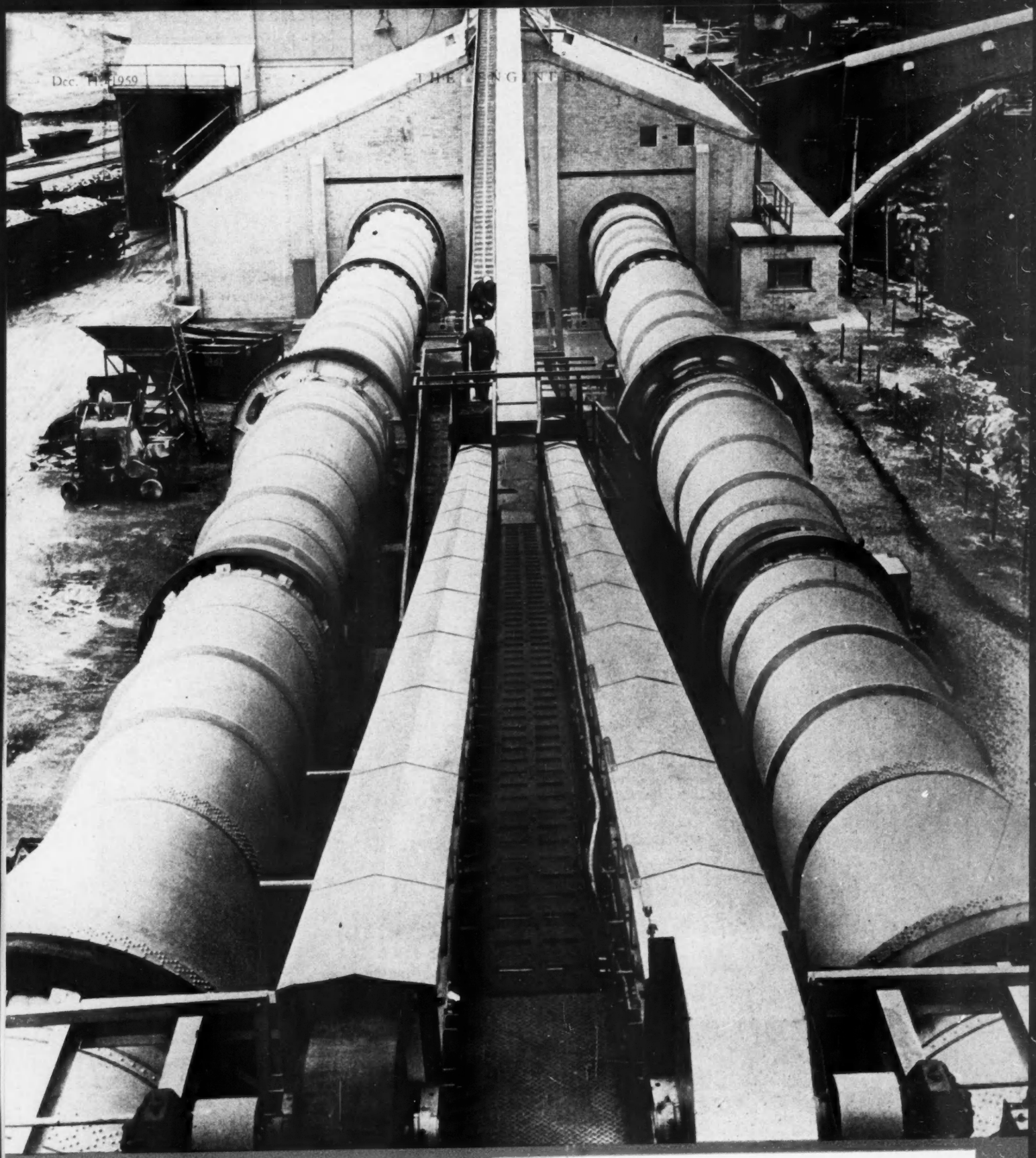

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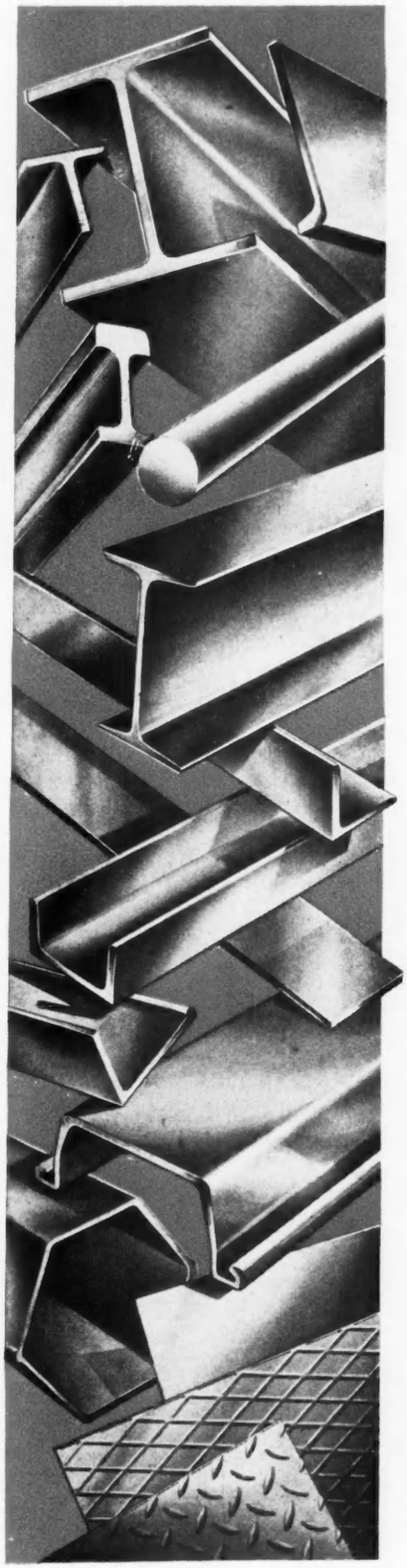

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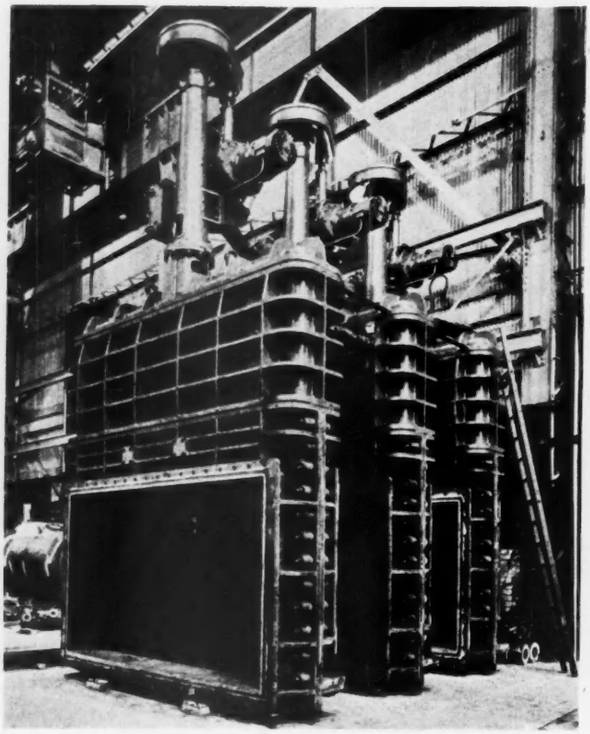

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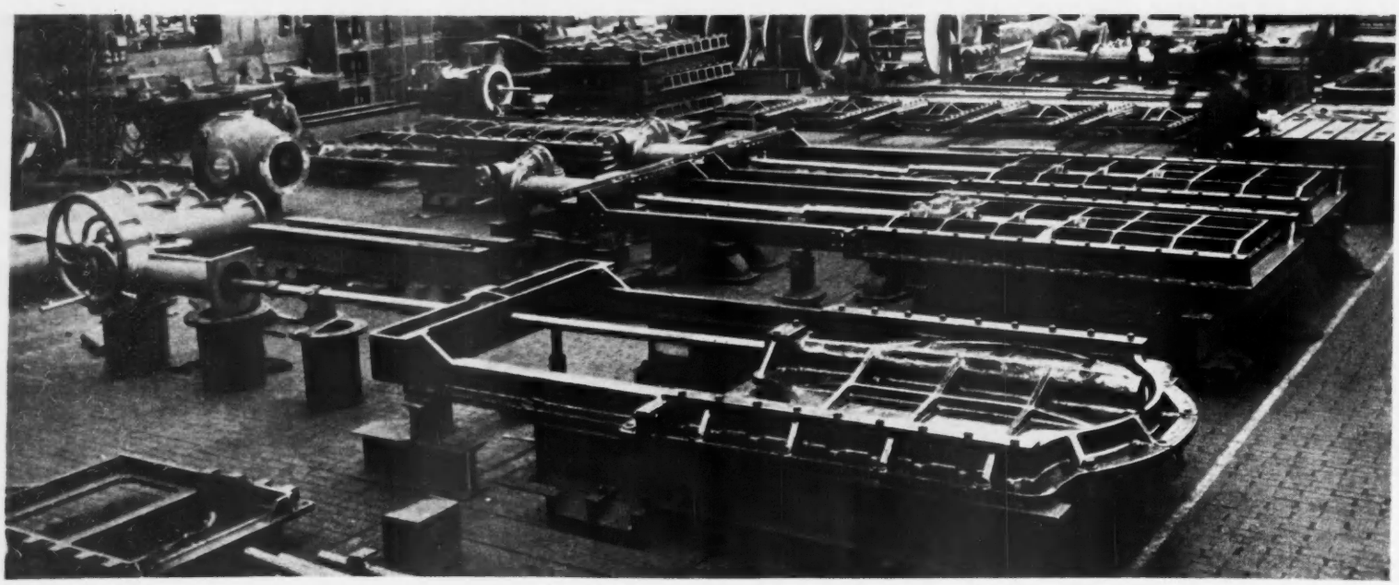

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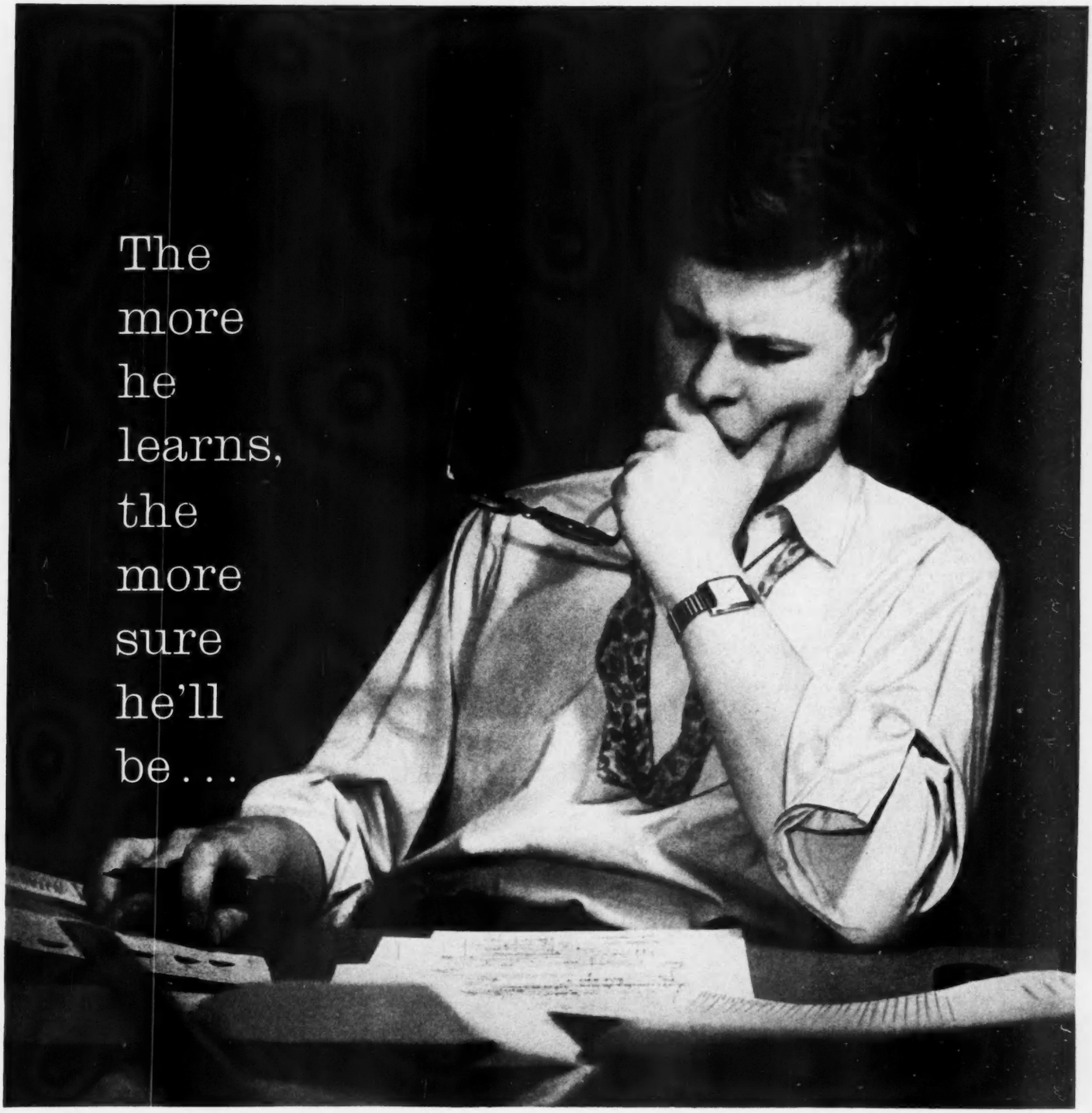


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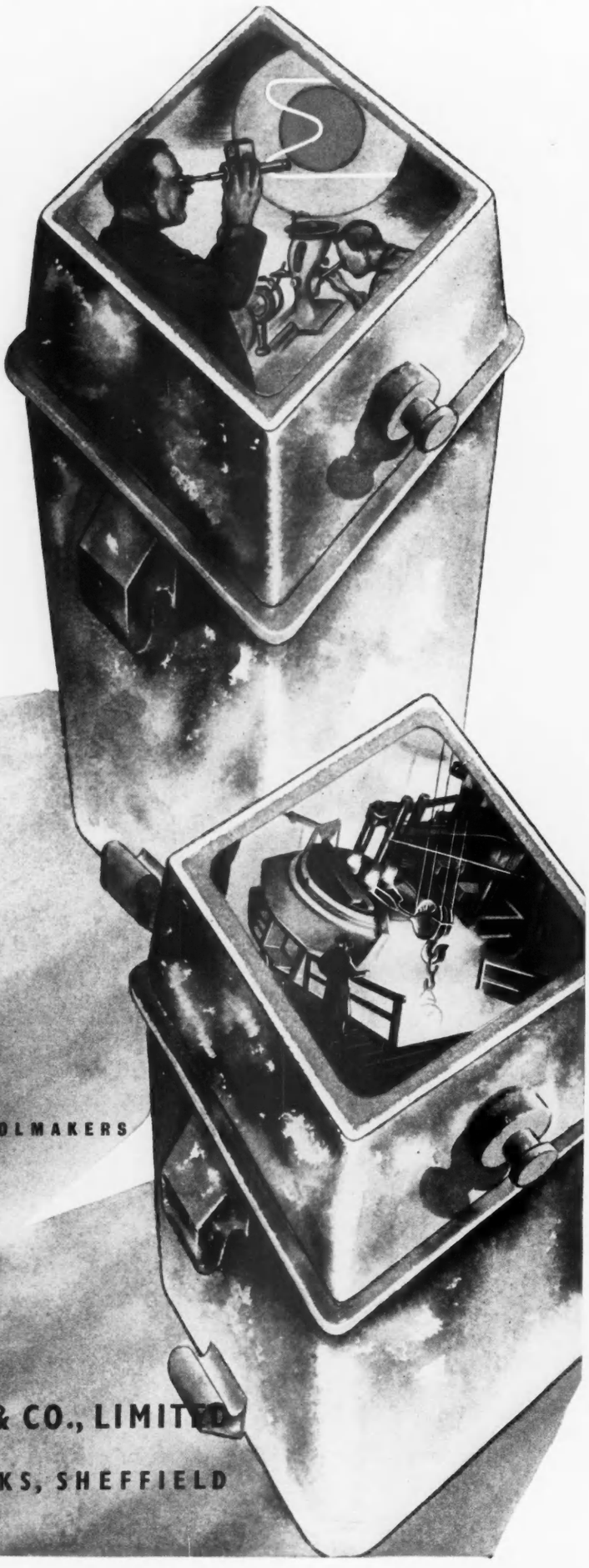

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*...read the fact-packed* **JOY WN.112** *Catalogue*
**All you wish to know about WN.112 compressors is contained in Catalogue AD/6. A copy will be sent immediately on request.**

**JOY-SULLIVAN LIMITED, AIR POWER DIVISION, 7 HARLEY STREET, LONDON W.1** **Telephone: LANGHAM 7711**

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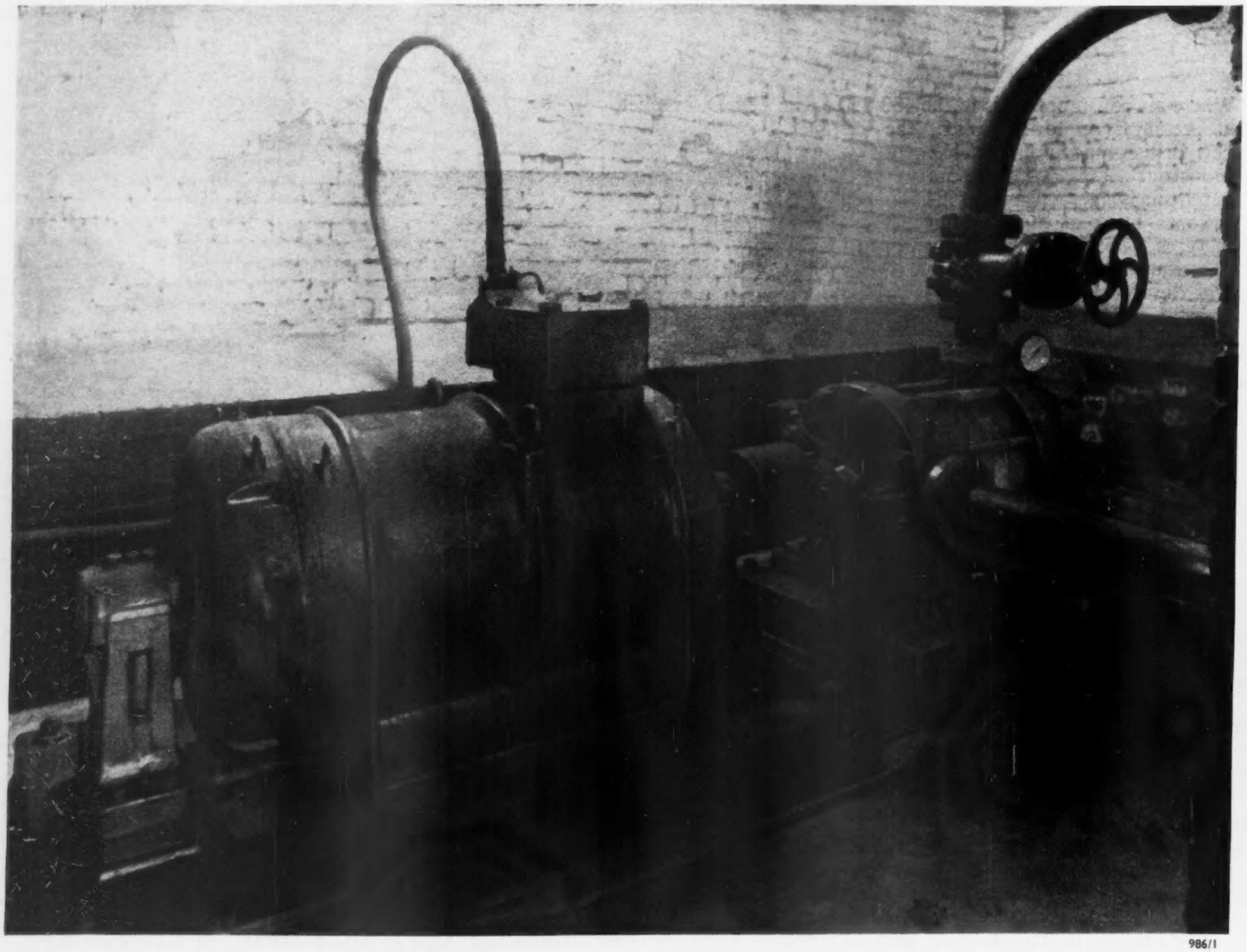
# PUMPS and MOTORS

## * *for reliable service on exacting duties*



986/1

**MATHER & PLATT LTD.,**
**PARK WORKS,**
**MANCHESTER, 10.**

*Telephone : COLlyhurst 2321*
*Telegrams : Mather, Manchester*

Mather & Platt pumps and motors are used all over the world, giving reliable service on important and exacting duties of all kinds. The illustration shows a Mather & Platt pumping set at a Yorkshire colliery. The pump delivers 200 g.p.m. at 1475 r.p.m. against an 800ft. head. It is driven by a 75 b.h.p., 3,300 volt, 3-phase, totally-enclosed, fan-cooled (frame-ventilated) flameproof motor.

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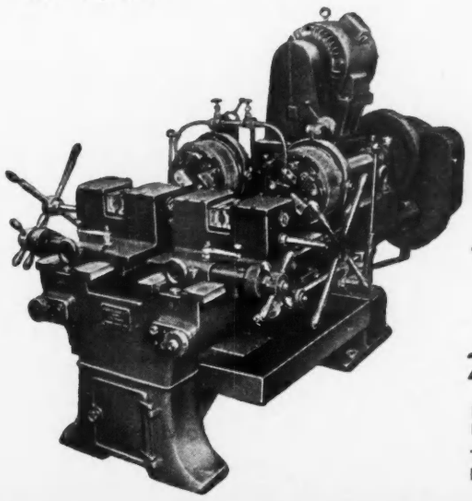

# Double production! with HEAP'S

## 2½ in. DOUBLE HEAD BOLT SCREWING MACHINE

Designed for really high output the HEAP'S Automatic 2½in. Bolt Screwing Machines will cut either right- or left-hand threads (or both at the same time).

The machine is fitted with our patent TANGENTIAL Die Heads, which open automatically when any predetermined length has been threaded. Capacity : Bolts up to 2¼in. dia., pipes up to 2in. dia., parallel or taper.

**JOSHUA HEAP & Co LTD** — ASHTON-UNDER-LYNE, ENGLAND

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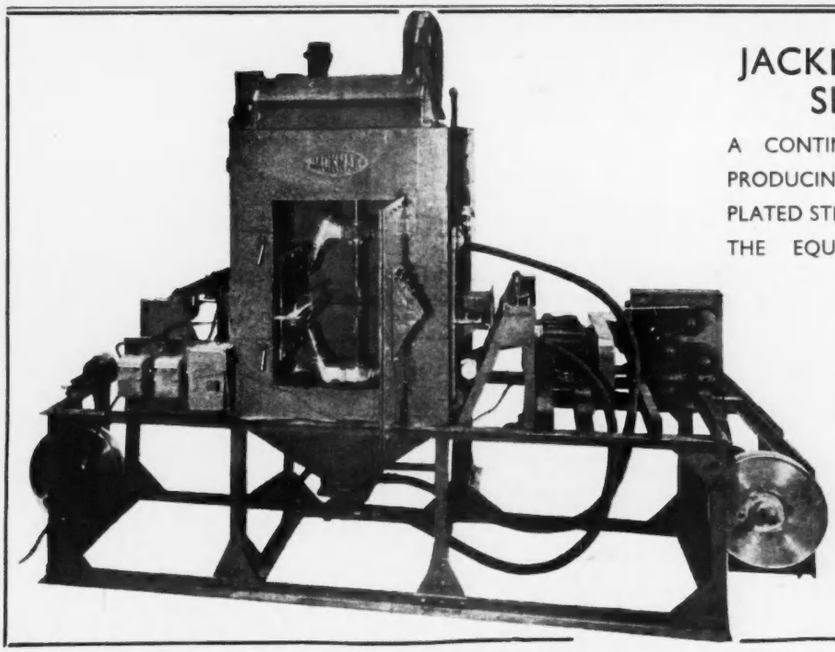

## JACKMAN FOR SPECIAL PURPOSE SHOT BLAST EQUIPMENT.

A CONTINUOUSLY ACTING AIR OPERATED PLANT FOR PRODUCING A MATT FINISH ON BOTH SIDES OF NICKEL PLATED STEEL STRIP IS SHOWN IN THE ILLUSTRATION.
THE EQUIPMENT IS COMPLETE WITH COILING GEAR.

FOR FURTHER DETAILS OF OUR RANGE OF AIR OPERATED SHOT BLAST EQUIPMENT PLEASE SEND FOR OUR BULLETIN No. 4.

**J. W. JACKMAN & CO. LTD.**

VULCAN WORKS · BLACKFRIARS ROAD · MANCHESTER 3
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**To the Largest Dimensions and Capabilities**

PATENT CUTTER HOPPER DREDGERS. PATENT DIPPER DREDGERS. BUCKET DREDGERS. GOLD AND TIN RECOVERY DREDGERS. FLOATING CRANES

Hopper Barges, Screw Steamers, Side & Stern Paddle Wheel Steamers, Tugs, &c.
New Buckets, Links, Pins, Gearing, etc., supplied for existing Dredgers

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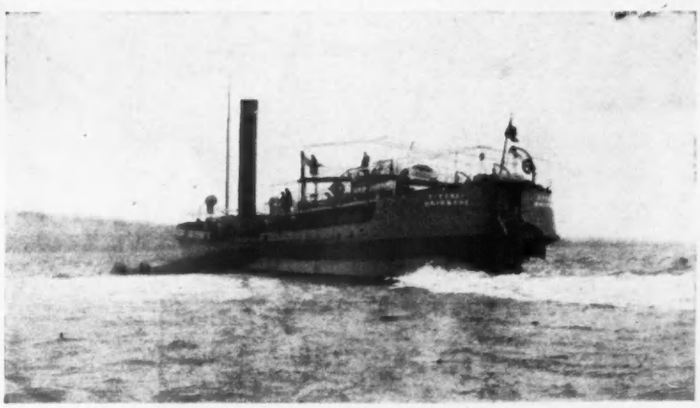
*'Phone :—Paisley 4121. Tele. Add.—"Phœnix, Paisley."*

London Office: 54-62 Regent Street, W.1. Tel. Regent 6247



**TWIN-SCREW TRAILING SUCTION HOPPER DREDGER "FITZROY"**
built for the
**QUEENSLAND GOVERNMENT, FOR ROCKHAMPTON**
Dredging capacity : 1,000 cubic yards per hour
Vessel can suck from its 800-ton hopper delivering to a distance of 1,000 feet to a height of 16 feet.

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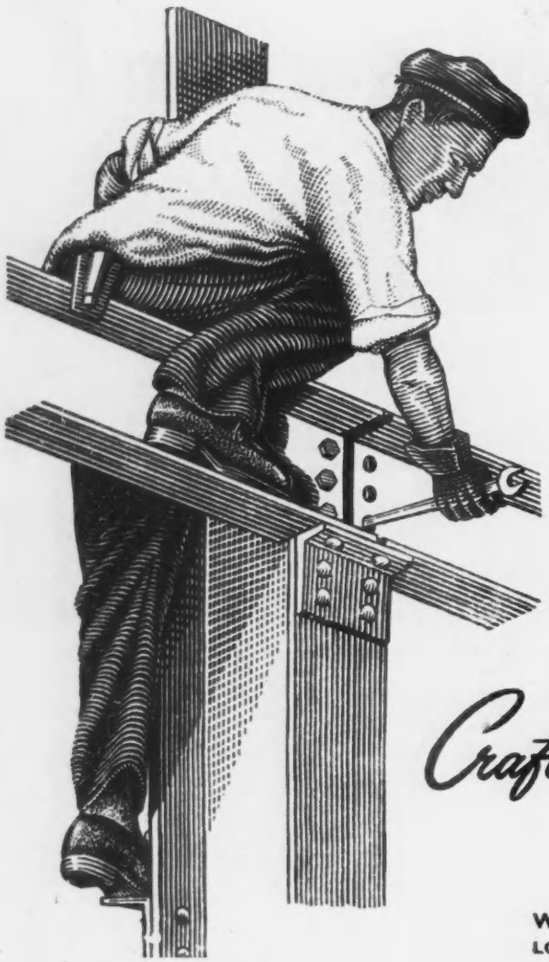

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If over 90 years spent in the design, fabrication and erection of structural steelwork means anything—it means you can place this work in our hands knowing it will progress smoothly to completion. Large job or small, we have the resources to handle all your needs. We welcome the opportunity of serving you.

*Craftsmen in steel* ..

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WALKER BROS LIMITED *Structural Engineers*

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# Bunkering

Traffic of oil at a discharging port is not quite all one way. While the cargo oil is coursing to the storage tanks, fuel oil for the ship's bunkers should be speeding in the opposite direction. The IMO Pump illustrated, of 250 tons/hour capacity, does this job at Finart with the reliability and trouble-free operation which is essential. Other U.K. oil ports are adopting this IMO Pump type DHEB 140/3. Full information on request.

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**MIRRLEES (ENGINEERS) LIMITED**

*Subsidiary of The Mirrlees Watson Company Ltd.*

EARL HAIG ROAD, HILLINGTON, GLASGOW, SW2

London Office: 38 Grosvenor Gardens, SW1

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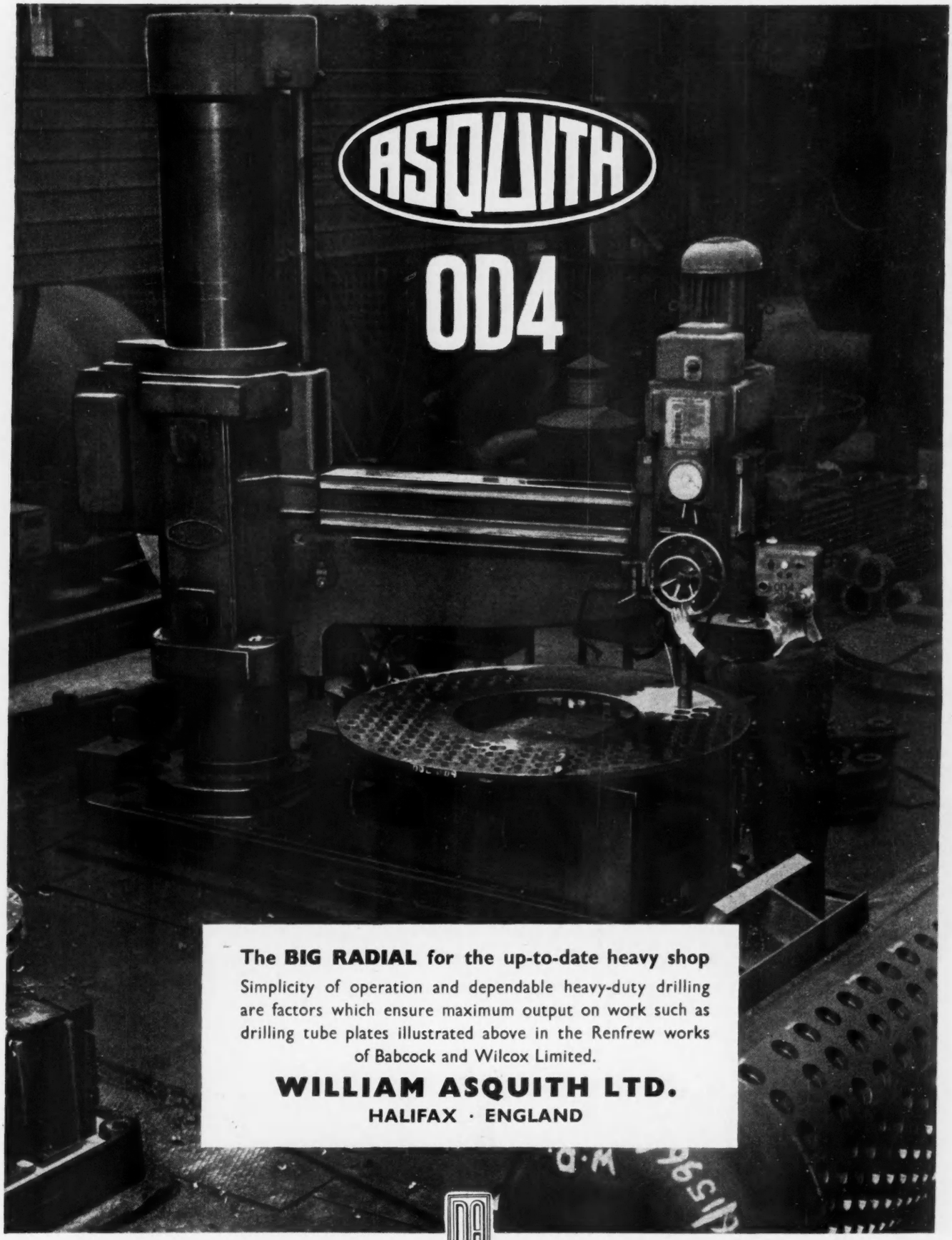


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Simplicity of operation and dependable heavy-duty drilling are factors which ensure maximum output on work such as drilling tube plates illustrated above in the Renfrew works of Babcock and Wilcox Limited.

**WILLIAM ASQUITH LTD.**
**HALIFAX · ENGLAND**

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*Sales and Service for the British Isles*

**DRUMMOND-ASQUITH LIMITED**

KING EDWARD HOUSE, NEW ST., BIRMINGHAM *Phone: Midland 3431. Also at LONDON Phone: Trafalgar 7224 & GLASGOW Phone: Central 0922*

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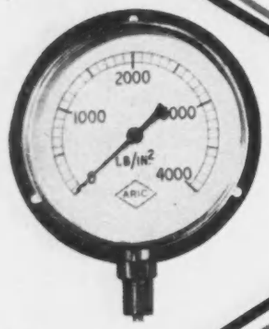
RECORDING INSTRUMENT
CO.

**pressure gauges for industry**

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manufactured under ideal conditions backed by years of experience and know-how

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IRISH SUBSIDIARY
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SOLID STEEL

DROP FORGED

all sizes from ¼" to 3" whit.

ARMSTRONG STEVENS & SON LTD.
WILLENHALL STAFFS.

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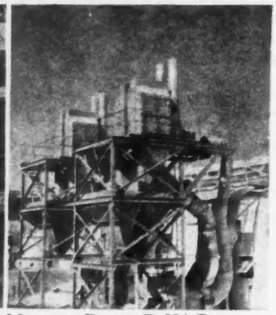
# SPECIALISTS IN GAS CLEANING AND DUST COLLECTION

*The following brochures describe our activities in the high efficiency recovery of fine particle dusts, mists and fumes, and are available on request.*

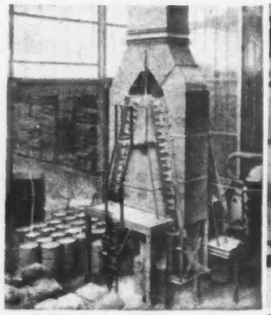
- The Mancuna-Mistex and Fumex fibre filter for fine acid mist and fume recovery *
- Dust Extraction and Collection.
- Dust Control Determination Method.
- The Mancuna Grit and Dust Sampling Device.
- The Mancuna-Dustex D.584 Collector.
- The M-40-A Mancuna Microclone.
- Grit Arrester at Grimsby Factory (reprint)
- Preparing for Dust Removal (reprint)
- High Efficiency Filtration for $CO_2$ Gas Cooled Nuclear Power Stations and Radio Active Dusts.

* *Manufactured under licence from Imperial Chemical Industries Limited.*

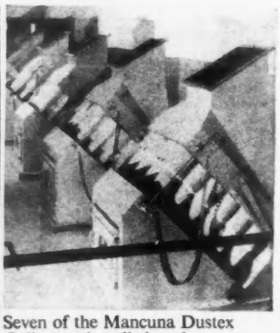
A combined plant comprising High Efficiency Primary Unit Cyclones and Multi-Cyclone Collectors in series for Unilever Ltd., Sao Paulo; recovers virtually 100% spraydried detergent powder.



Mancuna Dustex D.584 Cast Iron Miniature Cyclone Dust Collectors operating with Rotary Dryers on Limestone.



196 tube M-40-A Microlone installed for the recovery of synthetic resin powder.



Seven of the Mancuna Dustex Collectors installed at the Millennium Mill of Spillers Ltd., London.

**MANCUNA ENGINEERING LIMITED**

Denton, Manchester. Tel : DENton 3965 (5 lines)
*London Office :*
59 Victoria Road, Surbiton, Surrey. Tel : Elmbridge 9793
*Scottish Agent :*
Ian D. Macdonald, 18 High Street, Paisley. Tel : Paisley 2406

MANCUNA

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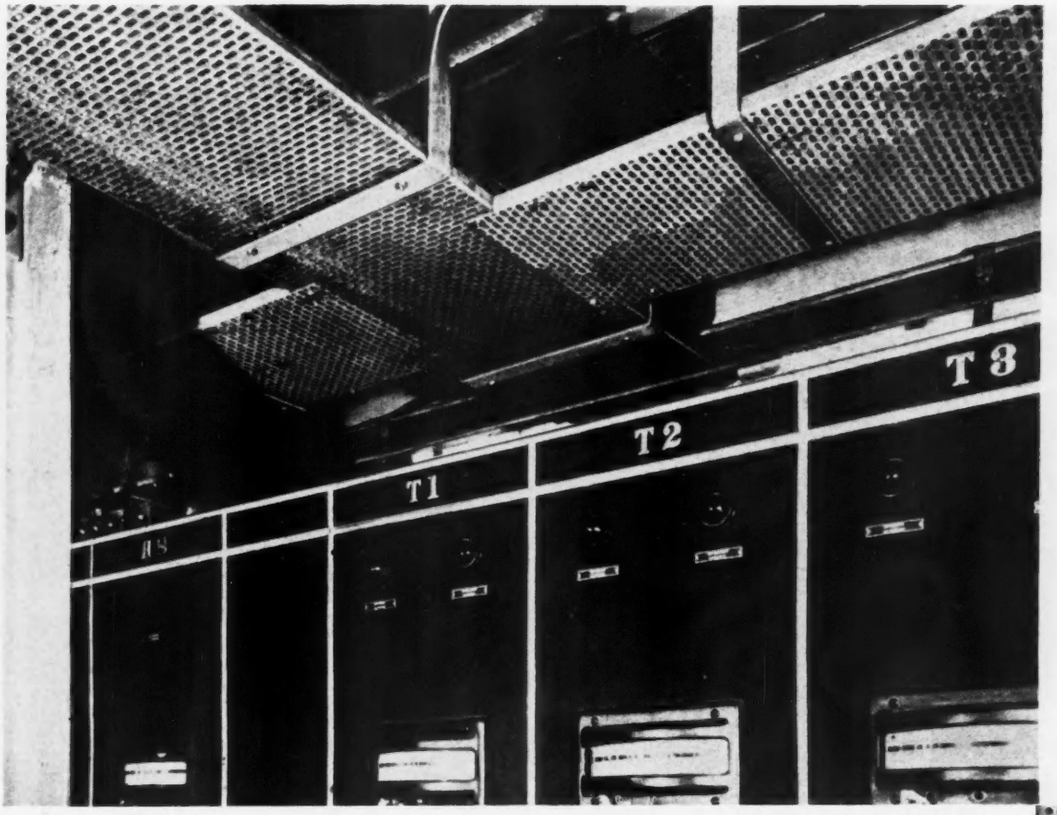
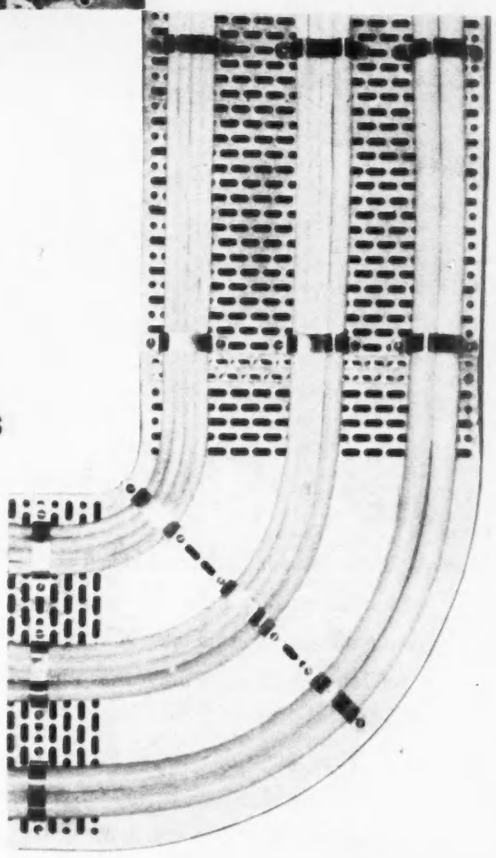



# Bruby

## CABLE PLATES AND BENDS



Provide a neat, speedy (no drilling) and economical means of installing electric cables. Supplied in mild steel—self colour, painted, galvanized after manufacture or plastic coated. Also supplied in aluminium alloy.

**FREDERICK Bruby & COMPANY LIMITED**

**LONDON:** 352-364 *Euston Road, N.W.1. Telephone: EUSton 3456* **CRAYFORD:** *London Works, Thames Road, Kent. Telephone: Crayford 26262*

GLASGOW · LIVERPOOL · BRISTOL · BELFAST · PLYMOUTH

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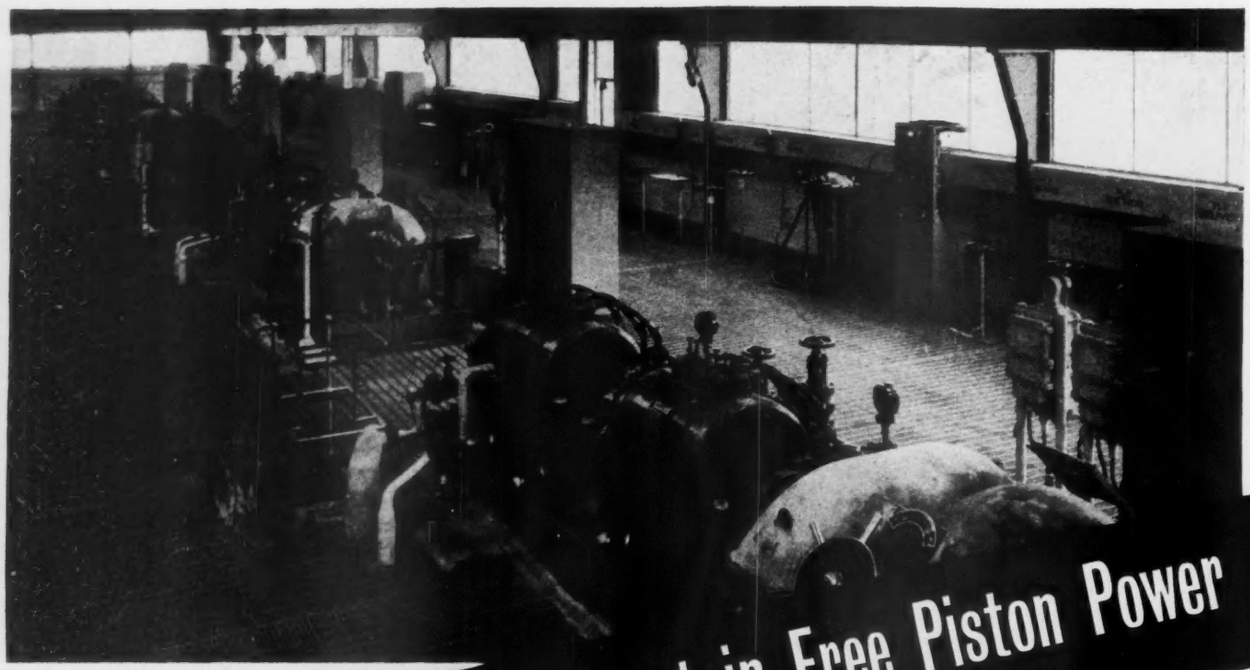
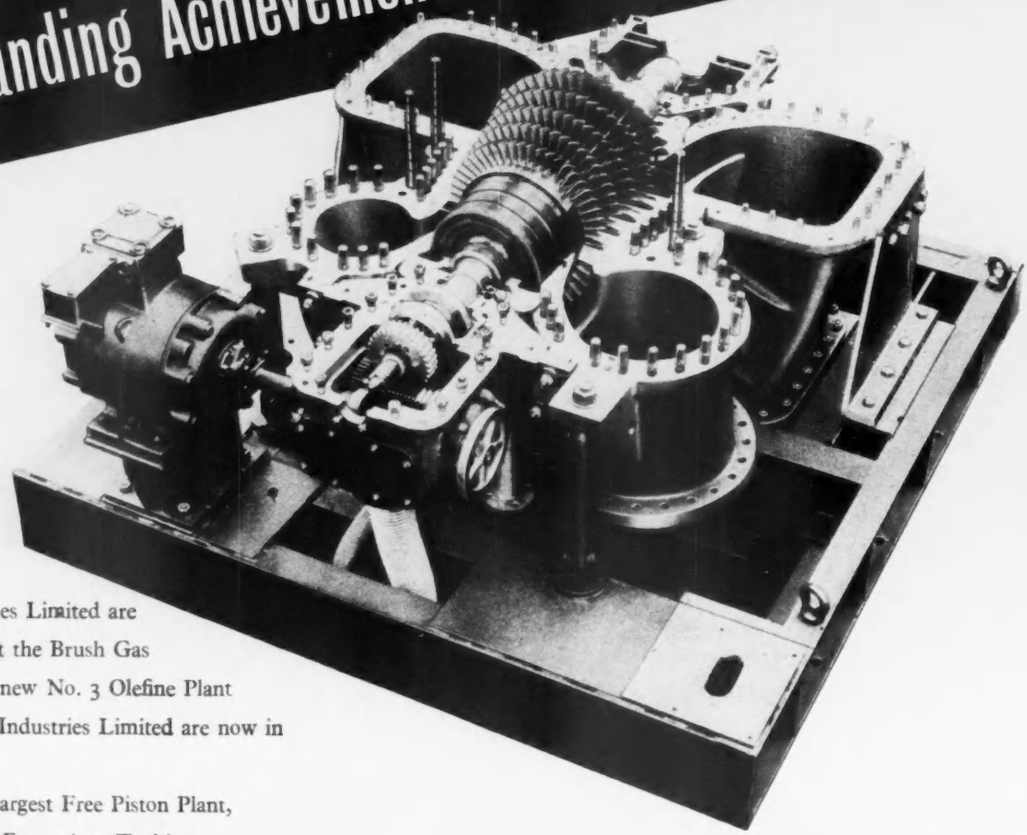


*Photograph by kind permission of I.C.I. Ltd.*

# An Outstanding Achievement in Free Piston Power



Hawker Siddeley Brush Turbines Limited are pleased to announce that the Brush Gas Expansion Turbines in the new No. 3 Olefine Plant of Imperial Chemical Industries Limited are now in operation.

This, the world's largest Free Piston Plant, incorporates six Gas Expansion Turbines totalling 16,000 h.p. and is the first application of Free Piston power to a Chemical Plant.

**HAWKER SIDDELEY** HSB **BRUSH TURBINES LTD.**

HUCCLECOTE, GLOUCESTER TELEPHONE: GLOUCESTER 67031

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*A Member of the Hawker Siddeley Group*

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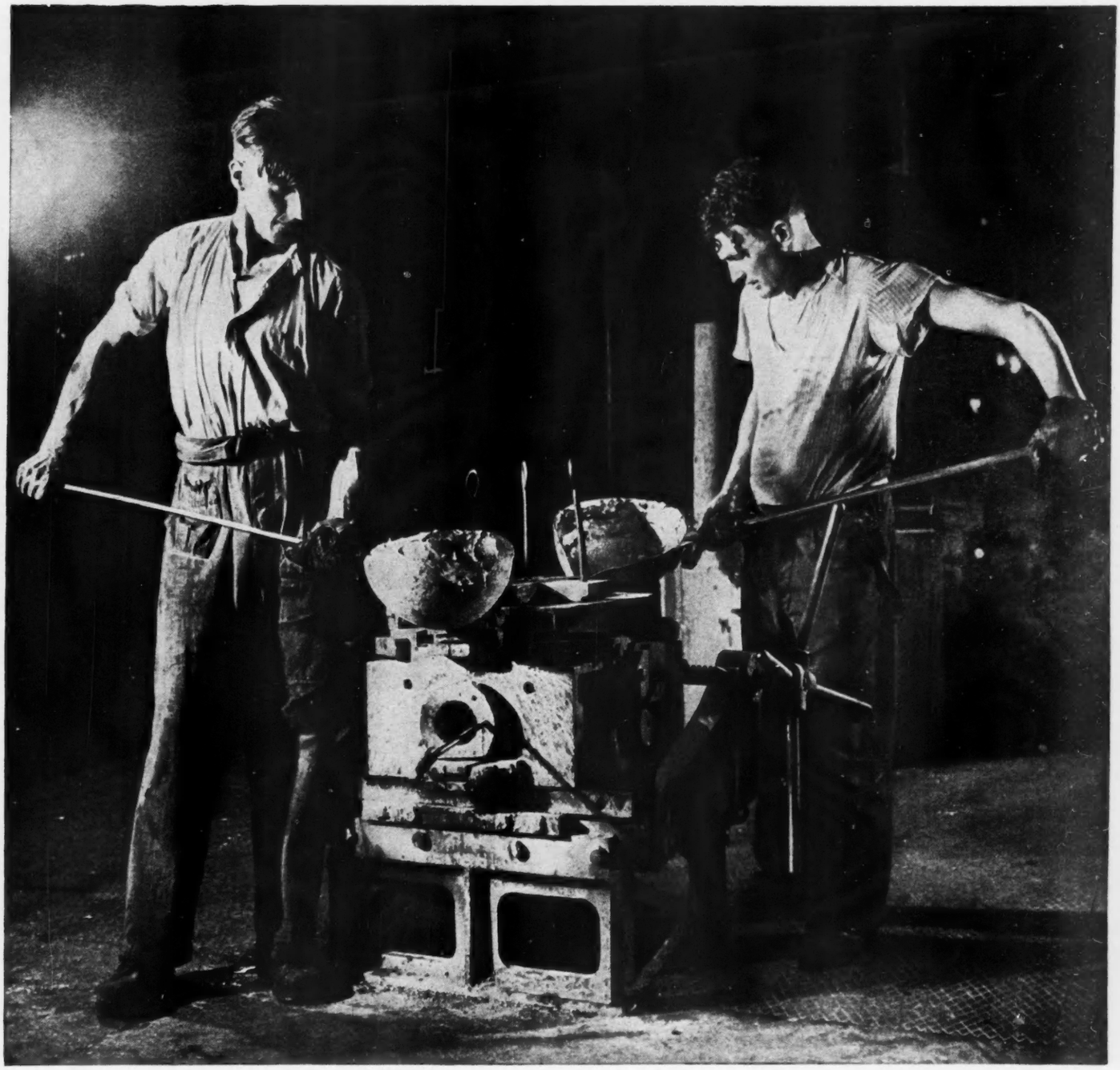
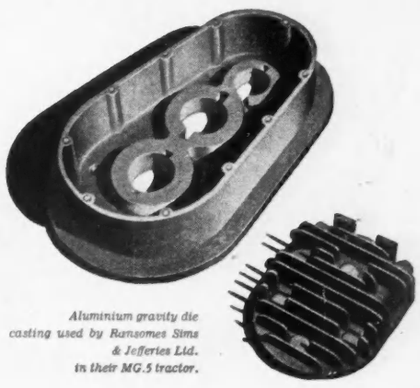


## Strictly to Specification

The selection of alloy for a given casting is influenced by design and foundry technique as well as by the physical properties required of the casting in service. Close co-operation between designer and founder is therefore desirable to determine the most suitable alloys and this must be effectively supported by regular checks of incoming materials and foundry melts to ensure conformity to specification.

**William Mills Limited**

**FOUNDERS IN ALUMINIUM ALLOYS**



*Aluminium gravity die casting used by Ransomes Sims & Jefferies Ltd. in their MG.5 tractor.*

**SAND CASTINGS GRAVITY DIE CASTINGS PRESSURE DIE CASTINGS** | FRIAR PARK FOUNDRY, FRIAR PARK ROAD, WEDNESBURY, STAFFS.

*AP118*

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A little muscle. A lot of brain. A knowledge of machinery. A sense of what is delicate. An avoidance of other people's toes. A respect for other people's time. A century and more of unrivalled experience.

If you have Plant to dismantle, to move, to reassemble — these are what George Cohen's will place at your disposal.

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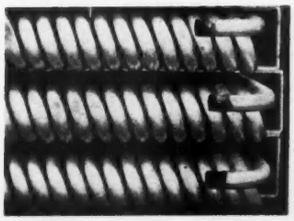
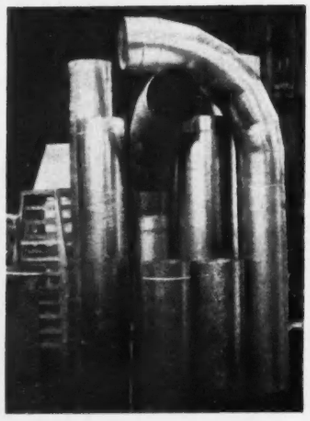
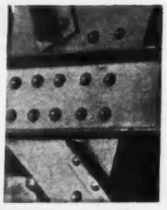
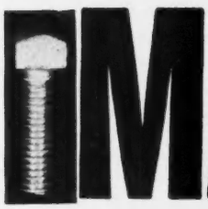


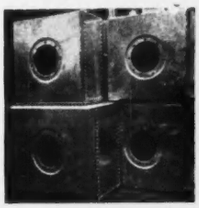
# HOT GALVANIZING



# FIRST MAKES STEEL LAST







For further information write to
the Hot Dip Galvanizers Association
34 Berkeley Square London W.1

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Published by Morgan Bros. (Publishers) Ltd.

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specialists in

- ★ light metal pressings and sections
- ★ stamping, forming, galvanising
- ★ argon and general welding
- ★ aluminium heat treated pressings

Our varied experience in engineering techniques and "know how" on up-to-date production methods, combined with skilled personnel and modern machinery, enables us to say with confidence, that we are able to offer an unequalled service for the highest quality work at the lowest possible prices, and reliable delivery.

*Your enquiries are invited :*
LIGHT ALLOY CONSTRUCTION LIMITED,

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5a Dean's Yard, London, S.W.1. *Abbey 1365.*

**LACON**

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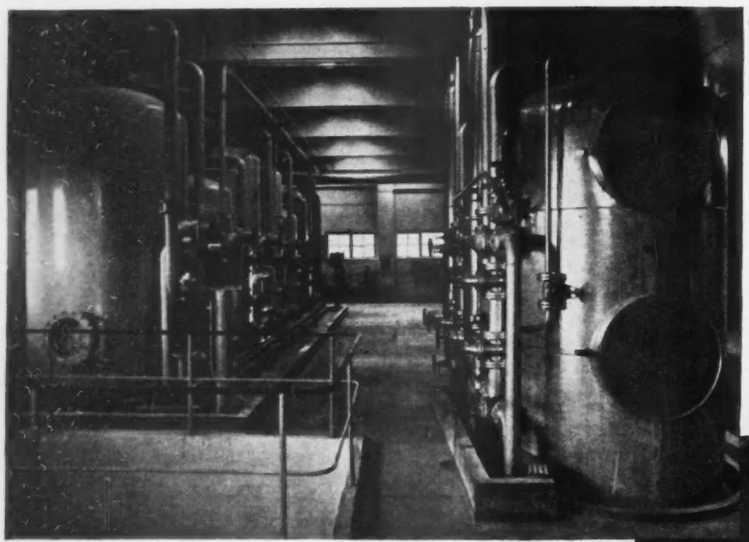
# WATER TREATMENT IN FINLAND

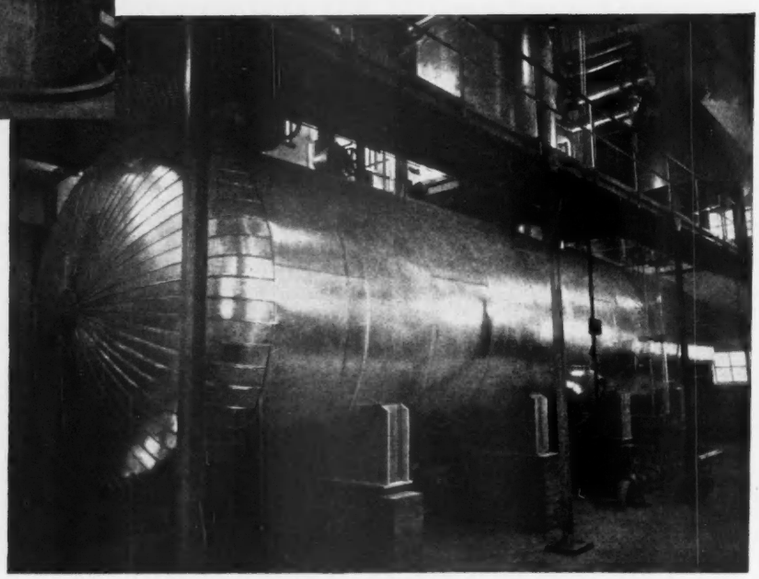
**Complete boiler-feed water-treatment plant for the new Veitsiluoto O/Y Paper Mills, Finland**

**Boiler pressure 1,750 psi, 42% make-up**



One of seven similar "Boby" installations in Finland treating highly organic lake-water for boiler feed purposes.
All plant made in Finland to the designs of William Boby & Co.

Demineralisation Plant for Boiler feed make-up, capacity 13,400 g.p.h. and base-exchange softener for condensate returns, capacity 18,000 g.p.h.



Deaeration Plant, capacity 250,000 p.p.h. with 30 minutes storage.

WATER BOBY TREATMENT

Established in 1875

## WILLIAM BOBY & CO. LTD.

RICKMANSWORTH, HERTFORDSHIRE, ENGLAND. Tel: Rickmansworth 4251

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**AGENCIES · DIRECTORS · PARTNERSHIPS · SITUATIONS VACANT · EDUCATIONAL PATENTS · BUSINESS OPPORTUNITIES · MISCELLANEOUS · PUBLIC APPOINTMENTS BUSINESSES and PREMISES · TENDERS**

**Lineage Rate.** 4/- per line of approximately 6 words. Minimum 16/-.

**Inch Rate.** 48/- per single column inch and pro rata. 12 lines to 1 inch. There are reduced rates (i.e., not on a pro rata basis) for advertisements of ¼-page (12 column inches) and upwards, e.g., ¼-page £25 10s. ½-page £48. Full page £90.

**AUCTION SALES · FOR HIRE · MACHINERY, etc., WANTED · SITUATIONS WANTED DRAWING AND DESIGN SERVICES · FOR SALE · SUB-CONTRACTING**

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**Series Discounts.** For advertisements 1 inch and upwards. 6 insertions 5%. 13 insertions 10%. 26 insertions 15%.

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**Displayed and Illustrated Styles.** The minimum size for a Displayed advertisement is 3 inches single column, for an illustrated advertisement it is a ¼-page (12 column inches). Thereafter the sizes for both progress in steps 3 inches deep across 1, 2, 3 or 4 columns.

**Use of Box Number.** 2/- which includes forwarding of replies.

**Copy Dates.** "Run-on" and "Semi-displayed" advertisements by noon Tuesday for publication on Friday same week. "Displayed" and "Illustrated" advertisements by noon Friday for publication on following Friday. All advertisements three days earlier if proofs are required.

***Advertisements for publication should be addressed to:*—Classified Advertisement Dept., "The Engineer", 28 Essex Street, Strand, London, W.C.2.**

*Urgent advertisements may be telephoned to CENtral 6565*

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**BRIGHTON TECHNICAL COLLEGE**

**ASSISTANT LECTURER (GRADE B) IN MECHANICAL ENGINEERING**

Required as soon as possible :
ASSISTANT LECTURER (Grade B) in MECHANICAL ENGINEERING. Graduate, A.M.I. Mech.E. or equivalent. Teaching experience is desirable.

Salary scale : £700 by £27 10s. (15) plus £37 10s. to £1150 (men), plus graduate and training allowances, with increments for approved research, professional or industrial experience.

Further particulars and forms of application from the undersigned, to be returned to the Principal, Brighton Technical College, Brighton, 7, within 14 days.

W. G. STONE,
Director of Education.

54, Old Steine,
Brighton. E8183

### NORTHAMPTON COLLEGE OF ADVANCED TECHNOLOGY, ST. JOHN STREET, LONDON, E.C.1

**LECTURER AND SENIOR LECTURER**

Applications are invited for appointments as LECTURER AND SENIOR LECTURER in the Department of Civil and Mechanical Engineering. Applicants should be qualified to teach in courses for the Engineering Degree and Diploma in Technology, and for Senior Lectureships should be able to make some contribution in post-graduate teaching or research. One post requires experience in bridge design in metal and concrete.

These appointments are additional to the present staff and arise from the rapid growth in the work of the College.

Salary scales : Lecturer, £1370 rising to £1550 ; Senior Lecturer, £1550 rising to £1750, plus in each case London Allowance of £38 rising to £51 at age 37.

Further particulars and forms of application are obtainable from the Secretary. E8173

### UNIVERSITY OF BIRMINGHAM

**DEPARTMENT OF INDUSTRIAL METALLURGY**

**LECTURER**

Applications are invited for a LECTURER in the Department of Industrial Metallurgy, to lecture on the scientific principles underlying the metal working processes to final-year and post-graduate students. Good facilities are provided for research. Candidates should have a good Degree in Metallurgy or Engineering and industrial or research experience. A knowledge of slip line field theory would be an advantage. Salary within range £900–£1650 with F.S.S.U. and family allowances.

Applications (three copies), with the names of three referees, should be sent to the Deputy Registrar, The University, Birmingham, 15, from whom further particulars may be obtained. E8161

### WIGAN AND DISTRICT MINING AND TECHNICAL COLLEGE

**LECTURER**

Applications are invited for a post as LECTURER in charge of Workshops in the Department of Mechanical Engineering. Duties will commence on a date to be arranged.

Candidates should hold a City and Guilds Full Technological Certificate in Machine Shop Engineering or equivalent qualification and have suitable experience in teaching and/or industry. Experience in repair and maintenance of mining machinery an advantage.

Salary Scale : £1370 by £35 (4) and £40 to £1550 per annum. Allowance is given for relevant experience.

Further particulars and application form will be sent by the undersigned. Last date for receipt of applications. Monday, 4th January, 1960.

E. C. SMITH,
Principal.

E8176

### UNIVERSITY OF WESTERN AUSTRALIA

**DEPARTMENT OF MECHANICAL ENGINEERING**

**(a) SENIOR LECTURER OR LECTURER (b) LECTURER**

Applications are invited for the above-mentioned positions in the University of Western Australia. Owing to continued expansion of the Engineering School, two new vacancies exist in the Department of Mechanical Engineering. Applicants should hold an Engineering degree (preferably Honours) and should have had industrial or research experience in mechanical engineering. Previous teaching experience is desirable but not essential. Financial assistance is available for research work, and the recently completed Engineering buildings provide adequate facilities ; present projects include heat transfer, engine alternator governing, pitting of gear teeth, gas and oil lubrication, the mechanics of aslant rolling wheels and the design of new types of agricultural machinery. Conditions for research into the utilisation of solar energy are particularly favourable.

Salary scales : Senior Lecturer, £A2150–£A2500 ; Lecturer, £A1550–£A2050 p.a. The University will meet the cost of the appointee's passage to Australia together with those of his family ; assistance will also be given with housing and travel grants.

Conditions of appointment and general information are obtainable from the Secretary, Association of Universities of the British Commonwealth, 36, Gordon Square, London, W.C.1.

Applications close, in Australia and London, on 8th February, 1960. E8192

### UNIVERSITY OF QUEENSLAND

**SENIOR LECTURER IN ELECTRICAL ENGINEERING**

Applications are invited for the above-mentioned position. Applicants must hold an Honours Degree and preferably a higher degree in Electrical Engineering with specialisation in electronics.

The duties will include lectures in advanced circuit and field theory and arrangement of the appropriate practical work.

Salary : £A2160 to £A2510 p.a.

Further particulars are obtainable from the Secretary, Association of Universities of the British Commonwealth, 36, Gordon Square, London, W.C.1, or from the Registrar, University of Queensland, Brisbane, Queensland, Australia.

Applications close, in Australia and London, on 15th January, 1960. E8191

### AIR MINISTRY

**ROYAL AIR FORCE, HEYWOOD, LANCS.**

**DRAUGHTSMAN**

Air Ministry require a civilian DRAUGHTSMAN (Engineering) at Royal Air Force, Heywood, Lancs. Candidates must be British subjects.

Qualifications : O.N.C. (Mech.) or equivalent ; satisfactory completion of normal apprenticeship or equivalent training of not less than three years and workshop experience.

Salary : (Provincial), £530 to £736 on entry, depending on age and experience, rising to maximum of £850. Five-day week and 3 weeks 3 days' annual leave. Travelling expenses in United Kingdom in excess of 7s. 6d. paid to all candidates called for interview.

For application forms and full particulars, apply to Air Ministry (C.E.4b), London, W.C.1, or to any Employment Exchange, quoting Order Number City 3453. E8227

### CIVIL SERVICE COMMISSION

**ARCHITECTURAL, CIVIL, AND PUBLIC HEALTH ENGINEERING DRAUGHTSMEN**

Pensionable posts for men and women aged at least 20 on 1st June, 1959, with at least 3 years' training, including adequate practical experience with appropriate technical study. At least one year must have been spent on full-time drawing-office work. Men's starting salary (London) £542 10s. (20) to £783 (28 or over). Scale maximum £900. Promotion prospects. Write Civil Service Commission, 17, North Audley Street, London, W.1, for application form, quoting S68-69/59/9. Closing date 31st December, 1959. E8195

### NORTH WEST METROPOLITAN REGIONAL HOSPITAL BOARD

**REGIONAL ENGINEER'S DEPARTMENT**

**SENIOR ASSISTANT ENGINEER (HEATING AND VENTILATING)**

Applicants should be Corporate members of the Institution of Mechanical Engineers, but applicants with Corporate Membership of the Institution of Heating and Ventilating Engineers will be considered. Engineers already employed in a professional grade in a Regional Hospital Board's Works Organisation may, in certain circumstances, be eligible for appointment without these qualifications. Candidates should have had considerable experience in the preparation of specifications, drawings and estimates for heating, ventilating and air-conditioning schemes and be capable of co-ordinating the work of a design team.

Present salary scale (under review) : £1050 by £30 (3) by £35 (3) to £1245, plus £50 London Weighting. Whitley Council conditions, modern offices, 5-day week, staff restaurant.

Apply, stating age, qualifications (with dates) and experience, with names of two referees, to Secretary, North West Metropolitan Regional Hospital Board, 40, Eastbourne Terrace, W.2, quoting reference 792 by 11th January. E8174

### GERMAN HOSPITAL, LONDON, E.8

(GENERAL, 157 BEDS)

**APPOINTMENT OF ASSISTANT ENGINEER**

Applications are invited for the above appointment, at a commencing salary of £595–£630 per annum, rising to £730 per annum. The successful candidate, who may also be required to undertake relief work elsewhere in the Group, will be required to supervise and actively participate in the maintenance and operation of the hospital's engineering services (both mechanical and electrical) under the direction of the Superintendent Engineer. Candidates should have experience in the operation of oil-fired boilers, and possession of the Ordinary National Certificate in Mechanical Engineering will be an advantage.

Application forms, obtainable from the undersigned, should be completed and returned by 19th December.

JOHN B. MANNING,
Group Secretary.

Hackney Hospital, E.9.
December, 1959. E8219

### BRITISH TRANSPORT DOCKS

**DOCK ENGINEER'S DEPARTMENT, GRIMSBY DOCKS**

**ENGINEERING ASSISTANT**

British Transport Docks invite applications for ENGINEERING ASSISTANT in the Dock Engineer's Department, Grimsby Docks.

Candidates should have experience in design, construction and maintenance of civil engineering works and preparation of cost estimates, contract drawings and documents. Associate Membership of one of the Engineering Institutions desirable. Salary range : £1045–£1150 per annum. Contributory superannuation scheme and certain rail travel facilities.

Applications, stating age, education, training, experience and qualifications, to be sent to : Staff and Establishment Officer, British Transport Docks, 163, Euston Road, London, N.W.1, to arrive not later than Friday, 18th December, 1959. E8167

### MINISTRY OF TRANSPORT

**CIVIL ENGINEERS**

Pensionable posts for men and women at least 25 and under 35 on 1st January, 1959 (extension for regular Forces service, Overseas Civil Service, established civil service, and temporary Government service as Civil Engineer). Candidates must have achieved Corporate Membership of Institution of Civil Engineers or passed examinations necessary for attaining such membership. Experience in road and bridge construction essential ; knowledge of Highways Authorities' procedure desirable. Starting salary (men, London) from £830 to £1125 according to age. Scale maximum (London) £1300. Promotion prospects. Write Civil Service Commission, 17, North Audley Street, London, W.1, for application form, quoting S64/7. E8198

### ROYAL NAVAL SCIENTIFIC SERVICE

**SENIOR SCIENTIFIC OFFICERS AND SCIENTIFIC OFFICERS**

SENIOR SCIENTIFIC OFFICERS and SCIENTIFIC OFFICERS required in following localities :

LONDON AREA : MECHANICAL ENGINEER with sound knowledge of basic principles of thermo and fluid dynamics, to carry out research programme in particular field of applied hydrodynamics. Experience in modern methods of design and research on axial flow compressors, turbines or pumps an advantage. MECHANICAL ENGINEER for research on precision gear design. MECHANICAL ENGINEER for work on propulsion problems. APPLIED MATHEMATICIAN for research of basic nature on stability of underwater vehicles ; knowledge of theoretical hydrodynamics and theory of control mechanisms an advantage. APPLIED MATHEMATICIAN or THEORETICAL PHYSICIST for acoustic analysis. APPLIED MATHEMATICIAN for work with electronic computers, with special reference to research into general underwater physical problems. ELECTRONIC PHYSICISTS for data handling and analysis problems. EXPERIMENTAL PHYSICIST for research in underwater acoustics. PHYSICIST interested in operation performance. CLASSICAL PHYSICISTS.

BALDOCK : PHYSICISTS or APPLIED MATHEMATICIANS for research in Metal or Quantum Physics.

PORTSMOUTH : PHYSICISTS with experience in field of microwave techniques. ELECTRONIC/ELECTRO-MECHANICAL ENGINEERS (experience in servo-mechanisms an advantage).

HASLEMERE : ELECTRONIC ENGINEER.

PORTLAND : PHYSICISTS or APPLIED MATHEMATICIANS for research in underwater acoustics. PHYSICISTS (general). ELECTRICAL ENGINEERS with advanced electronic design experience. MECHANICAL ENGINEERS. PHYSICAL CHEMISTS.

POOLE : CHEMICAL ENGINEERS. CHEMISTS with experience in rubber technology.

ROSYTH : MECHANICAL ENGINEER with experience in welding development. ELECTRONIC PHYSICISTS.

Candidates must normally be natural born British subjects of natural born British parents, with First or Second-Class Hons. Degrees or equivalent qualifications. S.S.O.s must have had three years' post-graduate experience and be not less than 26 years of age. Salaries (men) : S.S.O., £1233–£1460 ; S.O., £655–£1150 (London), somewhat lower in provinces.

Appointments unestablished (with F.S.S.U. benefits), but opportunities may occur for those under 32 to compete for established posts.

Forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1 (quote A.483/9A). E7844

### CIVIL SERVICE COMMISSION

**(a) SENIOR SCIENTIFIC OFFICERS (b) SCIENTIFIC OFFICERS**

Pensionable posts for men or women in all major scientific fields, including physics, chemistry, biology, forensic science, meteorology and mathematics. Age limits : (a) at least 26 and under 31 ; (b) at least 21 and under 28. Extension for regular Forces Service and Overseas Civil Service. Qualifications : normally first or second class honours degree in science, mathematics or engineering, or equivalent attainment ; additionally for (a), at least 3 years' relevant (e.g. post-graduate) experience. London salaries (men) : (a) £1233 to £1460 ; (b) £655 to £1150 ; provision for starting pay above minimum. Promotion prospects. Write Civil Service Commission, 17, North Audley Street, London, W.1, for application form, quoting (a) S53/59, (b) S52/59. Closing date 31st December, 1959. E8197

### EAST SURREY WATER COMPANY

**ENGINEERING ASSISTANT**

ENGINEERING ASSISTANT, preferably young man with University degree and some experience, for new works and general duties. Salary £900 to £1,000, depending on capabilities.—Apply, with names of two referees, to Chief Engineer, East Surrey Water Company, London Road, Redhill, Surrey. E8089

**Classified Advts. continued on page 142**

## PUBLIC APPOINTMENTS

### CENTRAL ELECTRICITY GENERATING BOARD

#### NORTH EASTERN AND YORKSHIRE REGION

#### STANDARDS ENGINEER

Applications are invited for the post of REGIONAL STANDARDS ENGINEER with Headquarters in Leeds.

Applicants should have had a good training in Electrical and Mechanical Engineering and should have had experience in connection with manufacture, erection, maintenance or operation of plant installed in modern Power Stations and associated transmission systems.

A knowledge of the Industry in respect of consumable stores, plant spares, stores procedure and the engineering market will be an advantage.

Candidates should preferably have qualifications leading to Corporate Membership of the Institutions of Mechanical Engineers or Electrical Engineers.

The salary for the appointment, which is superannuable, will be within the range of Senior Assistant Grade of the N.J.B. Agreement, Schedule "B" (i.e. between £1365 and £1865) and will commence at a point commensurate with qualifications and experience.

Applications, stating age, qualifications, experience, present position and salary should be forwarded to the Assistant Regional Secretary (Personnel), Central Electricity Generating Board, 1, Whitehall Road, Leeds, 1, so as to arrive not later than 4th January, 1960. E8213

### ANGLESEY COUNTY COUNCIL

#### APPOINTMENT OF COUNTY WATER ENGINEER AND MANAGER

Applications are invited for the appointment of COUNTY WATER ENGINEER AND MANAGER to the Anglesey County Council Water Undertaking, the statutory area of which covers the whole of the County of Anglesey.

Applicants must be Corporate Members of the Institution of Civil Engineers and the Institution of Water Engineers. The salary will be within the scale £1862 by £70 by £65 by £65 by £65 to £2127 per annum. A house will be provided to the successful applicant free of rent and rates, valued for superannuation purposes at £100 per annum. The appointed officer will be paid an essential user's car allowance. The appointment is subject to the conditions of service recommended by the Joint Negotiating Committee for Chief Officers of Local Authorities, the passing of a medical examination and three months' notice on either side. Canvassing disqualifies.

Further particulars and form of application obtainable from the Acting Clerk of the County Council, Shire Hall, Llangefni, Anglesey. Closing date for applications, 8th January, 1960.

IDRIS DAVIES,
Acting Clerk of the County Council.

Shire Hall,
Llangefni,
Anglesey.
7th December, 1959. E8236

## TENDERS

### CITY OF LEEDS

#### WATERWORKS DEPARTMENT

#### YORK ROAD RE-DEVELOPMENT AREA

#### BOOSTER PUMPING STATION

The Waterworks Committee of the Leeds City Council invites TENDERS for the SUPPLY, ERECTION and MAINTENANCE of an ELECTRICALLY DRIVEN AUTOMATIC BOOSTER PUMPING PLANT having a capacity of 140 gallons per minute against a total head of 150ft. complete with Switchgear, Motors, Time Controls, Air Pressure Tank, Air Compressor, Piping and Valves.

Plan, Specification and Forms of Tender and Instructions to Persons Tendering may be obtained upon application to the undersigned.

Forms of Agreement and Conditions of Contract and the Institution of Electrical Engineers General Conditions of Contract (Home Contracts—With Erection) may be seen at the Waterworks Department, Room 15, Civic Hall, Leeds, 1.

The Waterworks Committee does not bind itself to accept the lowest or any Tender.

Tenders must be enclosed in plain sealed covers endorsed "Tender for Pumping Plant—Waterworks" and be delivered at the Town Clerk's Office, Room 57, Civic Hall, Leeds, 1, not later than 12 noon on Friday, 1st January, 1960.

KENNETH L. FORSTER, M.I.C.E.,
General Manager and Engineer.

Civic Hall,
Leeds, 1. E8148

### INDIA SUPPLY MISSION, WASHINGTON, D.C.

The India Supply Mission, Washington, D.C., invites TENDERS for the SUPPLY of :

CENTRIFUGAL BLOWERS—for exhausting gases and vapour.
(1) To handle 500 c.f.m. of air at 4in. S.P. 2 Nos.
(2) To handle 1500 c.f.m. of air at 2in. S.P. 2 Nos.

FABRICATED OF UNPLASTICISED RIGID POLYVINYL CHLORIDE.

Forms of Tender may be obtained from the India Store Department (C.D.N. Branch), Government Building, Bromyard Avenue, London, W.3, upon a payment of a fee of 14s. 3d. per tender which is not returnable. Tender closing date in Washington is 6th January, 1960. Reference No. SE-78/Rein.Mis.6 must be quoted in all applications. E8210

## TENDERS

### COMMISSIONERS FOR THE PORT OF CALCUTTA

#### 60 TONS TWIN SCREW CRANE VESSEL

#### INVITATION TO TENDER

TENDERS are invited from experienced firms for the CONSTRUCTION, SUPPLY and DELIVERY afloat at the Port of Calcutta, in accordance with the specification, the contract drawings and the conditions of contract complete in all respects for the service intended of :

ONE TWIN SCREW STEAM 60 TONS CRANE VESSEL

so as to reach the Chief Mechanical Engineer, Calcutta Port Commissioners, 8, Garden Reach Road, Kidderpore, Calcutta-23, not later than 1700 hours I.S.T. on the 7th day of March, 1960, and the Consulting Engineers not later than 11.30 hours G.M.T. on the same day.

Tender documents may be obtained either from the Chief Mechanical Engineer, Calcutta Port Commissioners, or from the Consulting Engineers, Messrs. Rendel, Palmer and Tritton, 125, Victoria Street, Westminster, London, S.W.1, on deposit with the Treasurer, Calcutta Port Commissioners, 15, Strand Road, Calcutta, or with the Consulting Engineers, of the sum of £2000 or Rs.26,667/– as "Earnest Money" which will be refunded to unsuccessful Tenderers on the award of the Tender being made, and in the case of successful Tenderer this amount will be adjusted towards the security deposit. The cost of Tender documents, which will not be refunded, amounting to £3 or Rs.40/– per copy should be paid together with the Earnest Money.

Tenders in sealed envelopes, endorsed on the outside "Tenders for New 60 Tons Crane Vessel," are to be submitted in triplicate, of which two copies are to be sent to the Chief Mechanical Engineer and the remaining copy to the Consulting Engineers.

Tenders will be opened at the offices of Messrs. Rendel, Palmer and Tritton and the Chief Mechanical Engineer shortly after the closing time referred to above, and any Tenderer who wishes to be present at the time of opening may do so.

Quotations from the Tenderers must be firm and remain open for a period of 16 weeks from the closing date.

The Calcutta Port Commissioners do not bind themselves to accept the lowest or any Tender and reserve the right to accept or reject any Tender without assigning any reason. E8162

### INDIA STORE DEPARTMENT

The Director General, India Store Department, Government Building, Bromyard Avenue, Acton, London, W.3, invites TENDERS for the SUPPLY of :

| | Quantity Nos. |
|---|---|
| DOUBLE ACTING, TELESCOPIC HYDRAULIC SHOCK ABSORBERS | 790 |

Forms of Tender may be obtained from the above address on or after the 11th December, 1959, upon payment of a fee of 10s. which is not returnable. If payment is made by cheque, it should please be made payable to "High Commissioner for India." Tenderers must send their tenders so as to reach this Office by 2 p.m. on Monday, 18th January, 1960.

Please quote Reference No. 38/59.DB/RLY.2. E8187

### MINISTRY OF TRANSPORT

#### MEDWAY TOWNS MOTOR ROAD

#### CONTRACT NO. 1

#### MEDWAY BRIDGE

TENDERS are invited from Contractors with considerable experience of major bridgeworks for the CONSTRUCTION of the MEDWAY BRIDGE across the river Medway near Rochester, and of SHAKE HOLE and NEW CUXTON ROAD BRIDGES over the railway line from Sole Street to Rochester on the west bank of the river Medway. Tenderers will be required to submit with their Tenders particulars of major bridgeworks which they have previously carried out.

The Medway Bridge comprises 17 Viaduct Spans of 100ft. to 135ft. and three River Spans of 313ft., 500ft., and 313ft. The bridge carries a two-lane dual carriageway motor road with hard shoulders, and also cycle tracks and footways. The roadway is approximately 116ft. above water level.

The viaducts consist of reinforced concrete deck slabs cast on top of precast, prestressed concrete beams which are supported by reinforced concrete portal piers founded on piles or on spread footings. The foundations for the two main river piers which support the river spans are founded on hard chalk reached by open excavation inside steel cofferdams. The piers are hollow shafts of reinforced concrete or steel.

Alternative Tenders are invited based on prestressed concrete and welded steel designs of the superstructure for the three river spans.

Contract documents and drawings can be obtained from the Consulting Engineers, Messrs. Freeman, Fox and Partners, at 68, Victoria Street, Westminster, S.W.1, on payment of a deposit of £50 by cheque or Payable Order made payable to the Minister of Transport. The deposit will be refunded if a bona fide tender is submitted and not subsequently withdrawn.

Contract documents and drawings may be inspected by appointment at the office of the Consulting Engineers before payment of the deposit.

Tenders must be submitted in a sealed, registered envelope marked "Tender for Medway Bridge," addressed to the Assistant Secretary, Highways Management and Services Division, Ministry of Transport, 21-37, Hereford Road, London, W.2, to arrive not later than 4 p.m. on Tuesday, 8th March, 1960.

The Minister does not bind himself to accept the lowest or any Tender.

H. GILLENDER,
E8196 An Assistant Secretary.

## TENDERS

### GOVERNMENT OF NEW ZEALAND

#### MINISTRY OF WORKS

#### WAIRAKEI GEOTHERMAL PROJECT : STAGE II: STEAM COLLECTION AND TRANSMISSION SYSTEM

TENDERS will shortly be invited for the SUPPLY and ERECTION of a complete STEAM COLLECTION AND TRANSMISSION SYSTEM to serve extensions now in hand at the Wairakei Power Station.

The Contract will include about twenty-four Steam Separators and the same number of smaller Pressure Vessels, Supports, Valves, Metering Equipment, Special Fittings, and Steam Pipework in varying sizes 8in. up to 42in. bore (predominantly 30in. bore this being of a total length of approximately 27,000 feet) suitable for working pressures up to 250 lb./sq.in.g.

Completion on site of the first section of the installation (amounting to about 80 per cent) is required by July, 1961, and completion of the whole installation by December, 1961. Firms who are interested should apply to Merz and McLellan, Milburn, Esher, Surrey, for further particulars. No further announcement will appear in the Press and manufacturers should regard this notice as the formal invitation to tender. E8184

### MINISTRY OF TRANSPORT

#### DARTFORD TUNNEL—TOLL EQUIPMENT

TENDERS will shortly be invited for the SUPPLY of TOLL COLLECTING EQUIPMENT for the Dartford Tunnel. Manufacturers who are in a position to supply complete equipment designed to meet the requirements of a comprehensive (non-ticket-issuing) system of toll collection and registration by vehicle classification, preferably with remote recording apparatus and with provision for automatic collection, are invited to furnish particulars of their products, manufacturing resources and experience in this connection. Communications from manufacturers who wish to be considered as possible Tenderers for the supply and installation of toll equipment for the above project should reach the Assistant Secretary, Highways Management and Services Division, Ministry of Transport, 21/37, Hereford Road, Paddington, London, W.2, not later than Friday, 22nd January, 1960.

H. GILLENDER,
E8228 An Assistant Secretary.

### INDIA SUPPLY MISSION

The office of India Supply Mission, 2536, Massachusetts Avenue, N.W. Washington 8, D.C., United States of America, invites TENDERS for the following :

TENDER ENQUIRY No. SE.114

For the SUPPLY of TWO INDUSTRIAL TYPE TRACTORS, Diesel, approx. 75 h.p. with drawbar for trailer attachment, payload about 10 tons, required by Neyveli Liquite Corporation, Ltd., Madras, India.

Tender documents, &c., relative to the above, can be obtained from the Co-ordination Branch, India Store Department, Bromyard Avenue, Acton, W.3, at a cost of 14 shillings and threepence per tender, and is not refundable. Tenders are to be returned direct to India Supply Mission, 2536, Massachusetts Avenue, N.W. Washington 8, D.C., United States of America, so as to reach them by the 8th January, 1960.

Specimen copy of the above enquiry can be seen at India Store Department, Vehicles Branch, Bromyard Avenue, Acton, W.3, under the following reference : S.3725/59/HEA/VEH. E8186

### HOGSMILL VALLEY JOINT SEWERAGE BOARD

#### DIESEL GAS OIL

TENDERS are invited for SUPPLY of 20,000 GALLONS DIESEL GAS OIL delivered to Board's Works, Lower Marsh Lane, Kingston upon Thames, by road tank wagon in 2000 gallon bulk loads as and when required during the year ended 31st March, 1961. Specification to accompany tender, which is to be delivered to undersigned by 1st January, 1960.

A. B. ROGERS,
Clerk to the Board.

Guildhall,
Kingston upon Thames E8177

## EDUCATIONAL

### BABCOCK & WILCOX FELLOWSHIP IN NUCLEAR ENGINEERING

#### QUEEN MARY COLLEGE (UNIVERSITY OF LONDON)

Applications are invited for this FELLOWSHIP, which is tenable in the Nuclear Engineering Laboratory of QUEEN MARY COLLEGE (UNIVERSITY OF LONDON). The laboratory is at present engaged in nucleonic, heat transfer, reactor stability and thermonuclear research, but applications will be considered from candidates with other interests in the field of nuclear engineering. The normal duration of the Fellowship will be three years, and its value will be from £700 to £1200 per annum.

Application forms and further details obtainable from the Registrar, Queen Mary College (University of London), Mile End Road, E.1, should be returned as soon as possible and in any case not later than January 30th, 1960. E8220 E

## EDUCATIONAL

### COLLEGE OF AERONAUTICS

#### TWO-YEAR DIPLOMA COURSE, 1960–1962

Applications are invited from suitably qualified men and women who wish to enrol for the Two-Year Diploma Course which begins in October, 1960.

This post-graduate course in Aeronautical Science and Engineering is intended primarily for University Graduates in Engineering, Science, or Mathematics, for Technical College Students who possess a good Higher National Certificate or Diploma and have appropriate industrial experience, and others with equivalent qualifications. The curriculum includes the subjects of Aerodynamics, Aircraft Design, Aircraft Economics and Production, Aircraft Electrical Engineering, Aircraft Materials, Aircraft Propulsion, Flight, and Mathematics.

All applications will be considered by the Board of Entry which may call candidates to attend at the College for written Entrance Examination in Engineering, Physics, Mechanics, and Mathematics, to be held on Monday, 21st March, 1960. Exemption from this examination will normally only be given to candidates possessing 1st or 2nd Class Honours Degrees in Science or Engineering, or reading for Honours Degrees. The Board may also require attendance for personal interview at a later date.

Candidates who possess Bachelors Degrees with 1st or 2nd Class Honours in Aeronautics, and also in Science or Engineering if they have adequate post-graduate experience, may at the discretion of the Board of Entry be accepted for entry to the second year of the course and qualify for the Diploma (D.C.Ae.).

Further information about the course and forms of application, which MUST be completed and returned not later than Saturday, 27th February, 1960, may be obtained from The Warden, The College of Aeronautics, Cranfield, Bletchley, Bucks. E7898 E

**A.M.I.MECH.E., B.Sc.,** City and Guilds, etc. Guarantee Postal Courses for all Exams. and Technical Divisions from Elementary to Degree standard including Automation Techniques. Approximately 95 per cent successes. 148-page prospectus free, on request.—B.I.E.T. (Dept. 22), 29, Wright's Lane, London, W.8. E114 E

## SITUATIONS VACANT

**APPLICANTS ARE ADVISED TO SEND COPIES NOT ORIGINALS OF THEIR TESTIMONIALS UNLESS OTHERWISE REQUESTED.**

### A.E.R.E., HARWELL

#### ESTIMATING ENGINEER

A professional engineer is required to prepare, after consultation with designers and scientists and from technical specifications and drawings, detailed cost estimates for the design, manufacture and erection of a wide variety of plant and equipment. He will be assisted by a small technical staff.

Salary : £1345–£1800 p.a.
Housing and Superannuation Schemes.

Please send postcard for details to Group Recruitment Officer (1522/25), U.K.A.E.A., A.E.R.E., Harwell, Berks.

E8190 A

**AIR TREATMENT ENGINEER** required for group of Mills near Manchester. Applicants should be capable of preparing schemes and estimates for new plants, and supervising erection and maintenance. Please state experience, technical qualifications and age.—BOX No. E8130, "The Engineer." A

APPLICATIONS ARE INVITED FROM

#### MECHANICAL ENGINEERS

between the ages of 40 and 45 years for the position of ASSISTANT in the CENTRAL SAFETY ENGINEERING DEPARTMENT of Richard Thomas and Baldwins, Limited, located at Newport, Monmouthshire.

The successful applicant will be required to assist in investigations in connection with schemes for Capital Expenditure Control and Safety Engineering in various parts of England and Wales.

The Company operates a generous pension scheme. As first selection will be made from applications, information about education and experience should be given in full.

Apply to : Chief Safety Engineer, Richard Thomas and Baldwins, Limited, 55, High Street, Newport, Mon.

E8181 A

**APPLICATIONS ARE INVITED** from ambitious and resourceful men to fill the position of TECHNICAL ASSISTANT to the Sales Manager of Electric Lamp Machinery Manufacturers near London. A permanent, progressive and interesting job is offered to the right person, who must possess a sound engineering and commercial background in the trade.—Applications, with full particulars of education, experience and salary required to BOX No. E171, "The Engineer." A

**APPLICATIONS ARE INVITED** for a responsible Commercial/Technical position in a small Electro-Chemical Engineering concern south of Birmingham. Candidates should have a chemical and/or metallurgical qualification and preferably have had commercial experience. Age group 30–35. Please give details of career and salary expected.—BOX No. E8215, "The Engineer." A

**CRANE DESIGNER DRAUGHTSMAN** required in the West Riding, Yorkshire, with sound knowledge of Overhead Travelling Cranes. Age 30 to 40 years. The work is interesting and of varying nature, and the future prospects are excellent. House provided if necessary. Give details of experience and salary required.—BOX No. E8142, "The Engineer." A

## BOOKS & PUBLICATIONS


***READY IN JANUARY–***

***"A complete library in two volumes.."***

# KEMPE'S

## Engineers Year-Book

*Edited under the direction of the Editor of "The Engineer"*

**1960 (64th Edition)**

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## SITUATIONS VACANT

### CHIEF DRAUGHTSMAN

required for Company engaged in the design and manufacture of Steam and Diesel Shunting Locomotives and General Engineering Work which includes Colliery Winding Engine Equipment. Applicants must have H.N.C. or equivalent and be capable of taking full charge of the Drawing Office. They should have the ability to organise and must possess drive and initiative. Preference will be given to applicants with experience of Locomotive Engineering. The position offers excellent prospects to the right man. Pension Scheme. Five-day week.—Write, giving details of experience, age and indication of salary expected, to The Director and General Manager, Andrew Barclay, Sons & Co., Ltd., Caledonia Works, Kilmarnock.

E9194 A

### CHIEF INSPECTOR

An experienced man is required for a medium/heavy Steel Foundry and Engineering Works in West Wales. The successful applicant will be directly responsible to the General Manager and will be required to reorganise existing Inspection arrangements in line with a newly-introduced production system.

The post will be well remunerated.

The Company operates a generous Superannuation scheme.

Applicants, preferably aged 30/40, should send details of past experience and qualifications by 22nd December, to :—

Management Development Department,
Richard Thomas and Baldwins, Limited,
47, Park Street, London, W.1.

E8182 A

**CHIEF INSPECTOR** required by rapidly expanding precision engineers in Mid-Kent. Must be capable of obtaining A.I.D. and A.R.B. approval, and able to control 50–60 skilled inspectors. A wide variety of components is produced and a good general engineering background is desirable. This is a challenging position for a man with ideas and originality of thought in a progressive organisation. Remuneration depends initially on experience but eventually on results. Contributory pension scheme.—BOX No. E2651, "The Engineer." A

### DRAUGHTSMAN

Applications are invited for the above post, which is located in Birmingham.

The work is interesting and varied and is mainly in connection with the design of industrial heating equipment. A knowledge of combustion technique and the use of refractories would, therefore, be an advantage.

Candidates should possess the Ordinary National Certificate in Mechanical Engineering as a minimum qualification.

The salary for the appointment, which is pensionable and subject to medical examination, will be within the range of £733–£853 per annum.

Applications, stating age, qualifications and experience, together with the names of two referees, should be addressed to the Industrial Relations Officer, West Midlands Gas Board, 6, Augustus Road, Edgbaston, Birmingham, 15.

E8238 A

### ELECTRICAL DRAUGHTSMAN

FISONS LIMITED require an ELECTRICAL DRAUGHTSMAN at their Head Office at Felixstowe. The work involves electrical designs, the preparation of specifications, and site duties in connection with lighting, power and distribution schemes for major capital projects in fertiliser and chemical factories throughout the country.

Applicants should preferably have experience in heavy industry, petroleum or chemical engineering Works, and should hold an Ordinary National Certificate at least (Higher National Certificate preferred).

Salary according to experience and qualifications.

The Company operates a Pension Scheme which for married staff includes provision for widows and dependent children.

Applications with full particulars should be addressed to Group Personnel Officer (JQ/4), Harvest House, Felixstowe, Suffolk.

E8221 A

### ENERGY

The B.I.S.R.A. has a vacancy for a University Graduate in Physics or Engineering in the Energy Section of their Plant Engineering Division in London. The work will involve research into new applications and the efficient use of energy in all its forms in the steel industry, which is the largest consumer of fuel and power in Britain.

The publication of research papers is encouraged by the Association. Starting salary up to £1020 per annum according to age, qualifications and experience. Post is superannuated under the F.S.S.U. Written applications only quoting "E.N.3" to the Personnel Officer, The British Iron & Steel Research Association, 11, Park Lane, London, W.1.

E8204 A

**DRAUGHTSMAN MECHANICAL (SENIOR)** required by the British Drug Houses, Ltd., for layout and special machine development in their chemical laboratories. H.N.C. or equivalent preferred. Five-day week, Canteen, Sports Club, Pension and Profit Sharing Schemes.—Apply in writing, stating age and educational attainments to the Staff Manager, Graham Street, City Road, N.1. E8231 A

**ENGINEER** for work in connection with site investigations and soil mechanics laboratory required immediately by Consulting Engineers, F. R. Bullen and Partners, Dacre House, Dean Farrar Street, London, S.W.1. E8233 A

**ENGINEERING, PHYSICS AND SCIENCE GRADUATES** required for research on the dynamic behaviour of machine tools and problems associated with the automatic control of machine tools. Opportunities will be given for developing results of research into new conceptions of machine design. Prospects are good for those having capacity for original thought and ability, and initiative to take complete control of any project. Superannuation scheme. Good working conditions.—Send full details in confidence to the Secretary (R.612), Production Engineering Research Association, Melton Mowbray, Leics. E8153 A

**ENGINEER SURVEYOR** required, for inspection of Boiler and Pressure Plant. Must have 1st Class M.O.T. Certificate with Steam Endorsement or equivalent. Car driver. Commencing salary £800, rising to £1100. Non-contributory pension and other benefits. Resident Oxford area.—Apply, Eng. Dept., GENERAL ASSURANCE CORP. LTD., 99, Aldwych, London, W.C.2. E8164 A

### ESTIMATING ENGINEERS

required by old-established engineering company. The work involved is estimating the cost of Diesel Locomotives and General Engineering, including welding, fabrications and sheet metal work.

It is not essential that candidates should be estimators provided they have a good practical background together with the ability to plan operations and assess operation times.

Applicants with experience of the above should apply in writing giving full particulars of past experience and age to :

Personnel Officer,
W. G. Bagnall, Limited,
Castle Engine Works,
Stafford.

E8215 A

**FIRM IN SOUTHERN ENGLAND,** manufacturing components for the motor industry, requires DESIGN DRAUGHTSMEN and JUNIOR DRAUGHTSMEN. Experience of gravity die casting an advantage. Write, stating age, details of experience, qualifications and salary required.—BOX No. E8199, "The Engineer." A

**GRADUATES OR EQUIVALENTS REQUIRED** for new appointments in the following fields :

(1) Applied research and development of press working processes, cold extrusion and other new techniques for the forming of metals.
(2) Applied research on machining processes ; initially work will be concerned with the appraisal of new machining developments or studies of machining costs on a comprehensive scale.
(3) Research, design and development of a variety of mechanical engineering equipment, including special machine tools, mechanisms, test rigs, &c.

Successful candidates will be expected to take complete responsibility for projects from conception to completion. Capacity for creative thinking and initiative are important. The conditions of employment are attractive and there are excellent prospects for advancement. Superannuation scheme. Removal expenses paid. Send full details in confidence to the Secretary, Production Engineering Research Association, Melton Mowbray, Leics. E8226 A

### INDUSTRIAL GAS REPRESENTATIVES

With the increase in the development and utilisation of gas for Industrial purposes, further appointments will be made in the Midlands to meet the demand.

The work will involve investigation and submission of schemes for the use of gas for furnace heating and other industrial purposes.

Applications are invited from candidates with an appropriate University Degree, or similar qualification. Experience of Industrial Gas is not essential as adequate training will be given.

The salary during the training period will be in the range of £733–£813 per annum, and subject to satisfactory completion of training, appointment to a permanent post on a higher grade will be made. The appointments are pensionable and subject to medical examination.

Applications, stating age, education, qualifications and experience, should be addressed to the Industrial Relations Officer, West Midlands Gas Board, 6, Augustus Road, Edgbaston, Birmingham, 15.

E8237 A

### INSTRUMENT ENGINEER

A firm of international reputation has a vacancy, at their Head Office, for a graduate in Mechanical or Electrical Engineering. The work embraces conventional and special purpose instrumentation, involving measurement, presentation and control of temperature, pressure, flow, pH, stress, strain, &c., for process control laboratories, as well as for plant and engineering services. This requires a knowledge of electrical, mechanical and pneumatic principles with practical experience of their commercial applications. Practical experience of electronics and optics is desirable. The ability to design and estimate for installations including safety circuits is also necessary.

This appointment offers good prospects and a satisfying career to a man who is keen to apply his knowledge to design and installation problems and to follow a project to its completion.

A contributory pension scheme is operative. Houses are available and assistance is given with removal expenses.

Applications, quoting 2/E/17.—BOX No. E8232, "The Engineer." A

**Classified Advts. continued on page 144**

## SITUATIONS VACANT

**MECHANICAL ENGINEER, NAVAL ARCHITECT OR CIVIL ENGINEER,** Degree or equivalent, required by progressive company in Sweden, to develop new marine product for the Oil Tanker industry. Experienced in the design, construction or running of tankers, must be prepared to live in Stockholm and to travel extensively. Knowledge of Swedish not necessary.—Apply to Hardy Tobin and Co., Ltd., 39, New Broad Street, London, E.C.2 (LONdon Wall 5237). E8178 A

**PLANT DESIGN ENGINEER.**—Applications are invited from Graduates, or equivalent, aged 30–35, with design and site experience in the Chemical or Oil Industries, enabling them to carry responsibilities including plant layout, piping design and interpretation of the line diagrams. The salary is good and the appointment is permanent and pensionable. Letters, which will be treated in confidence, should be sent to : The General Manager, Humphreys and Glasgow, Limited 22, Carlisle Place, London, S.W.1. E8151 A

**PLANT ENGINEER** required. To be responsible for all maintenance services of fruit and vegetable processing factory. This progressive position demands a man of vigour and energy, within the age range 25–35, who has had a sound, practical and technical training to H.N.C. level. Experience of food processing and packaging machinery an important advantage.—Apply, giving full details of age, experience, qualifications, &c., to Personnel Manager, ESKIMO FOODS LIMITED, Pelham Road, Cleethorpes. E8168 A

**PLANT ENGINEER** for Civil Engineering Plant Depot in Watford. Age 25–30. Experience of general workshop and welding procedure essential. Knowledge of heavy civil engineering plant an asset. Apply, stating age, full particulars of experience and approximate salary required.—BOX No. E8234, " The Engineer." A

**PUBLICATIONS DEPARTMENT** of BRITISH WELDING RESEARCH ASSOCIATION requires a DRAUGHTSMAN for preparation of ILLUSTRATIONS. The department is accommodated in a new building at Abington, near Cambridge. Five-day week, three weeks annual holiday, superannuation scheme. — Applications to the Secretary, B.W.R.A., 29, Park Crescent, London, W.1. E8214 A

**QUALIFIED ENGINEERS** with considerable experience of pipeline pump station and tank farm construction required by important firm for Middle East.—State age and full details to BOX No. 3052, c/o Charles Barker and Sons, Ltd., Gateway House, London, E.C.4. E8144 A

**SENIOR DESIGN DRAUGHTSMEN,** familiar with small mechanisms, etc., required by progressive and expanding Company situated approximately 20 minutes from Waterloo. The positions offered are permanent and provide excellent prospects for versatile men who seek interesting work in a new field.—BOX No. E169, " The Engineer." A

**SENIOR DESIGNER/DRAUGHTSMAN** required for Steelworks Consultants in the Midlands area. Steelworks experience desirable but not essential. The position is a progressive one and salary will be dependent on qualifications and experience. Non-contributory pension scheme. —Applications, giving age, qualifictions and experience, to The Salem Engineering Co., Ltd., Milford House, Milford, Derbys. E8154 A

**SENIOR PROJECTS ENGINEERS** required to lead a team engaged in the design and development of Sea Water Distillation Plant. Age about 30 to 40. Academic standard to Corporate Membership of a Senior Professional Institution. Experience of steam engineering and heat transfer problems. Permanent pensionable employment.—Apply in writing, stating age, experience and qualifications to Personnel Manager, Box SP1603, A.K. Advg., 212a, Shaftesbury Avenue, London, W.C.2. E8207 A

**SENIOR TEST ENGINEER** required, with experience in WIND TUNNEL TESTING of Compact Heat Exchangers. Experience in refrigeration an advantage. North West London area. Write.—BOX No. E8163, " The Engineer." A

**STEAM POWER STATION SUPERINTENDENT IN CANADA**

The above vacancy occurs at a 30MW Station. Candidates should be well educated and qualified and capable of taking complete charge of operation and maintenance. They must have had several years' practical generating station experience. Present steam conditions are 400 p.s.i., but knowledge of pressures to 900 p.s.i would be useful for future development. Salary 7,500 Canadian dollars per annum.—Applications should give full details of age, education, qualifications and experience to : Messrs. Macknes & Shipley, Parliament Mansions, Abbey Orchard Street, London, S.W.1, quoting reference 2463. E8205 A

**STRUCTURAL ENGINEERING DESIGNER** required in London office of Consulting Engineers. Should have a University Degree in Engineering or the Associate Membership of either the Institutions of Civil or Structural Engineers and must have had at least one year's experience on the design of structural steelwork. Some experience on reinforced concrete design would also be an advantage. Salary according to experience. Five-day week. Pension scherge. Luncheon vouchers. Apply, stating age and experience.—BOX No. E8152, " The Engineer." A

**TECHNICAL REPRESENTATIVE.**—National firm of Building and Civil Engineering Contractors with offices throughout the country require additional Technical Representation. The appointment, which is a senior post, will be based on a head office in Lancashire, but will entail travelling throughout the United Kingdom, for which purpose a car will be provided and all out-of-pocket expenses paid. The successful applicant will be paid a salary commensurate with the nature of the duties involved and will, in addition, participate in generous superannuation benefits. Applications, which will be treated in the strictest confidence, are invited from men engaged in a similar sphere who are in contact with Consulting Engineers, Architects and Industrialists at a high level. Reply, with details of experience, previous engagements and an indication of present salary.—BOX No. E8175, " The Engineer." A

**SUPERVISOR FOR MECHANICAL SERVICES**

An experienced Engineer required by Main Contractors to ensure that work of Specialist Sub-Contractors is being carried out efficiently and according to specification. He should be familiar with services in large industrial plants, including electrical, heating, ventilating, chemical and gaseous services. Experience of the design of such services would be helpful and also ability to vet and advise on specifications at tender stage. Sphere of operations mainly in Northern England. Excellent staff conditions, pension scheme, etc.

All applications will be treated confidentially but must contain full details of past and current employment, age, education, qualifications and approximate salary required.—BOX No. E8139, " The Engineer." A

**TECHNICAL REPRESENTATIVE (OUTSIDE)** wanted for Sheet Metal Machines and Machine Tools. South London and Home Counties area. Non-contributory Pension and Assurance Scheme.—Write in full to Managing Director, F. J. Edwards, Ltd., 359, Euston Road, London, N.W.1. E8223 A

**THE PERMUTIT COMPANY LTD.**

invite applications from a

SENIOR MECHANICAL DESIGN DRAUGHTSMAN, with experience in design of hydraulic control equipment,

and a

SENIOR ELECTRICAL DRAUGHTSMAN with experience in design of automatic control circuits and instrumentation.

These are permanent and pensionable positions with a good starting salary. Please apply to :— The Personnel Officer, Permutit House, Gunnersbury Avenue, W.4. E8104 A

**THE REED PAPER GROUP**

has vacancies for

**QUALIFIED MECHANICAL ENGINEERS**

in the Packaging Division Development Department at New Hythe, Kent. Aged between 25 and 35. Minimum qualification H.N.C. Industrial experience essential. These interesting appointments will entail the study of paper converting processes.

Reply to :

Packaging Division Development Department,
(Process Section),
The Reed Paper Group,
Aylesford, Kent.

quoting : ME/PDDD/95. E8230 A

**WANTED, FIRST-CLASS SENIOR DESIGN DRAUGHTSMAN** for firm of General Engineers in Bristol. Good knowledge of general engineering, with particular reference to pressure vessels and stainless steel fabrication. This will be a well-paid position for the top-class man.—BOX No. E164, " The Engineer." A

**YOUNG ENGINEER** (about 25 years) wanted to train as technical sales representative for machinery manufacturers. Birmingham area. Sales experience not necessary but knowledge of Sheet Metal Machines, Presses, Machine Tools essential. Car driver. Non-contributory Pension and Assurance Scheme. Details with starting salary.—BOX No. E8224, " The Engineer." A

**YOUNG MAN** with mechanical or chemical engineering training required for Sales or Contracts Department of Boiler and Industrial Plant Division. Permanent position with good prospects for right man.—Apply in writing, stating age, experience and qualifications to Labour Officer, BOX YM 1609, A.K. Advg., 212a, Shaftesbury Avenue, London, W.C.2. E8206 A

## CHIEF ENGINEER

Chief Engineer required by Permanite Ltd., established manufacturers of roofing felts, mastic asphalt and other bituminous building materials.

Successful applicant will have full control of Company's engineering staff, and be responsible to the Directors for maintenance of existing plant, development work to increase efficiency and improve quality, and design and erection of new plant from time to time. Duties will be principally at Company's Head Office and factory at Old Ford, London, and factory at Hertford.

Age preferably 35–45. A.M.I.Mech.E. or equivalent technical qualification essential, also previous experience in similar capacity or as assistant in larger organisation.

Car provided. Pension scheme and life insurance cover. Position ranks as one of the top executives in the Company. Good salary and prospects for applicant with suitable qualifications.

Apply, giving full details, to Chairman,
PERMANITE LTD.,
455, Old Ford Road, London, E.3.
E2652 A

W. H. ALLEN SONS & CO., LTD., QUEEN'S ENGINEERING WORKS, BEDFORD,
require at their
LEAMINGTON SPA BRANCH OFFICE
A

## QUALIFIED ENGINEER

aged 25–35, as a TECHNICAL SALES REPRESENTATIVE in connection with Power and Pumping Plant comprising Steam Turbines, Diesel Engines, Gearing, Pumps.

This appointment would necessitate residence at Leamington Spa and give the opportunity for considerable travel.

Generous Pension Scheme and holidays.

Apply, stating qualifications, experience and present salary, to the Personnel Manager (Ref. 829/202).

E8123 A

## AN ASSISTANT CHIEF ENGINEER

is required for a medium-heavy engineering works employing some 1400 persons. Applicants must have an Engineering degree or parallel qualifications in electrical or mechanical engineering and should preferably be Corporate Members of the appropriate Institution. As the successful candidate will have to take immediate control of a large maintenance organisation, it follows that only men with the requisite practical experience and authority of manner will be considered. A professional engineer of exceptional ability and personality is sought as it is essential that he should be able to develop well beyond the requirements of the present post in the relatively near future. The Company offers excellent conditions of employment, including a Pension and Life Assurance scheme.

Please write, giving full particulars of age, experience, qualifications, etc., to Managing Director, TUBES LIMITED, Rocky Lane, Aston, Birmingham, 6, marking envelope A.C.E.

E8122 A

**UNITED KINGDOM ATOMIC ENERGY AUTHORITY**
**announces the setting-up of a**

## CONSULTATION SERVICE

If you are an experienced scientist or engineer and think that you may be interested in a senior post (salary from £3000 upwards) with the United Kingdom Atomic Energy Authority, you can learn more about the opportunities available without committing yourself to making a formal application for a post.

**Arrangements can be made for an**
**Informal and confidential interview**

by telephoning or writing to Mr. H. S. Hoff, Personnel Consultant, U.K.A.E.A., 11, Charles II Street, London, S.W.1. (Whitehall 6262.)

The more relevant detail about yourself that you can supply in advance—qualifications, experience, age, &c.—the better.

**The interview will be entirely confidential : after it no further action whatsoever will be taken by the Authority unless you specifically request it.**

E8000 A

## NEWTON CHAMBERS
AND COMPANY LIMITED
Thorncliffe, near Sheffield

## Production Manager

in the EXCAVATOR DIVISION is required to direct and co-ordinate the activities of the Production Control, Production Engineering and Design Departments and to maintain effective liaison with the Sales Company. Applicants should have had practical experience in engineering production and possess a recognised engineering qualification.

It is probable that the selected applicant will be between 30 and 40 years of age.

The position is pensionable and assistance with housing is possible.

All applications will be treated in the strictest confidence and should be addressed to the Personnel Officer, Newton Chambers & Co., Ltd., Thorncliffe, near Sheffield.

E8235 A

## A PRODUCTION DIRECTOR

is required by progressive and expanding Company.

Applications are invited from Engineers with ambition to achieve Director status quickly.

The post requires an exhaustive knowledge and wide experience in up-to-date methods of tube fabrication and manipulation in all materials, and in the production of pressure vessels and heat exchangers to all codes.

An engineering degree or equivalent qualification would be considered an asset.

The preferred age range is 38 to 45.

Salary envisaged : £2000-£2500—bonus on results—Company car—Superannuation, &c.

Applications, giving fullest details in confidence, to BOX No. E2649, " The Engineer." A

SITUATIONS VACANT

## ASSISTANT ENGINEER

required for Extrusion Department. Candidates must be qualified at least to H.N.C. Standard and preferably with experience of heavy hydraulic plant.

Applications, giving details of qualifications and experience, to :

The Manager,
The British Aluminium Co., Ltd.,
Bank Quay, Warrington.

E8188 A

SITUATIONS VACANT

## TECHNICAL SALES ENGINEER

required by the British subsidiary in London of a world-wide Group for its Rare Metals Department.

This is a post for an efficient technical sales representative, at least 35 years of age, with a good basic knowledge of applied science. The post calls especially for sound commercial experience, preferably in the semi-conductor and atomic energy fields, but the necessary training will be given to the successful applicant.

The Company is young and progressive but well established and able to offer a satisfying career to the right man.

Good salary, car allowance, pension, life assurance, canteen, etc.

Please reply in writing, giving full particulars, including education, experience, salary required, etc. — BOX No. E8203, "The Engineer." A

SITUATIONS VACANT

## DEPUTY PRODUCTION ENGINEER

Required for a medium-sized company manufacturing specialised equipment for the vehicle and motor-car industries.

The Deputy Production Engineer will be responsible to the Production Engineer for the supervision of engineering staff covering process planning, work measurement, tool design and manufacture.

Candidates, who should have professional qualifications in production and mechanical engineering, must have extensive experience of modern machine tools, process planning, jig and tool design and work study in the light mass-production engineering field.

Experience in the design of special purpose transfer machines would be an advantage.

Age group : 30–45. Four-figure salary and non-contributory pension scheme. Please send full details of career in confidence, quoting reference LRM PE.1, to CLAYTON DEWANDRE COMPANY, LIMITED, Titanic Works, Lincoln.

E8211 A

SITUATIONS VACANT

## CENTRAL ELECTRICITY GENERATING BOARD
## NORTHERN PROJECT GROUP

require

## GROUP LEADER (CIVIL)

in the Drawing Office at Project Group Headquarters, Agecroft, Manchester. Salary within range £1090 by £30 to £1300 per annum.

Experience in Civil Engineering and Building works for Power Stations or similar contracts, including design and detail of reinforced concrete foundations, structural steelwork and roads and drainage is essential. Experience in control of draughtsmen engaged on this type of work would be an advantage.

Application forms available from Administrative Officer, Central Electricity Authority, Northern Project Group, Agecroft, Pendlebury, Swinton, Manchester, to be returned by 22nd December, 1959. Envelopes to be marked "Confidential—Staff Vacancy Notice N.59/38/E." E8201 A

BRITISH GUIANA

## MANAGER—SALES & ENGINEERING

Applications are invited for the appointment of Manager of the Car, Tractor, Engineering and Electrical Departments of Sandbach, Parker & Co., Ltd., Merchants, Engineers, &c., at their headquarters at Georgetown, British Guiana. Excellent commencing and progressive salary, expatriation allowance, furnished house or flat at low rent, free passages for self and family on engagement and for home leave every two years, free medical attention, local leave, contributory pension scheme, &c. Preferred age 30–40.

The Manager of the Car, Tractor, Engineering and Electrical Departments will be responsible to the Assistant General Manager and will be in charge of sales and service and responsible for controlling and co-ordinating the work of the departments indicated, employing about 25 people engaged in the sale and service of the entire Massey-Ferguson range of equipment, Standard motor cars, various heavy tractors, excavators, diesel engines, &c. His other main responsibility will be to promote sales of these products to industry, contractors, Government departments and farmers.

Qualifications required are sound engineering experience, preferably obtained in the contracting equipment and automotive industry and up to A.M.I.Mech.E. standard, allied with good sales experience in this field, plus the ability to supervise the erection and repair of equipment and the training of operators. Must also be able to establish and maintain sound customer relations and first-class service. Some previous overseas experience preferable but not essential.

Please write briefly in first instance, quoting Reference No. 298 to :

AA LTD

**ASHLEY ASSOCIATES LTD.**
PETER HOUSE, MANCHESTER 1.
*RETAINED TO ADVISE ON THIS APPOINTMENT*
*The strictest confidence will be observed and no details of candidates will be passed to clients without candidates' permission.*

E8200 A

MAY & BAKER, LTD.

DAGENHAM, ESSEX

require

## TWO SENIOR CHEMICAL PLANT DESIGN ENGINEERS

Candidates should have a good degree or equivalent. Preference will be given to candidates with at least five years' experience in design and commission of chemical or similar plant. There will be prospects of early promotion for one of the successful applicants to the position of Head of the Department.

## JUNIOR DESIGN ENGINEER

Candidates should have a good degree or equivalent and preferably about two years' experience in the chemical industry. Experience in the design of high vacuum plant would be an advantage.

There is a Pension Fund and Life Assurance Scheme in operation. Five-day week ; sports and social club.

Apply initially in writing to the Personnel Officer, quoting Reference No. 155/59.

E8202 A

## DESIGN AND DEVELOPMENT ENGINEERS

## ENGLISH ELECTRIC
### Whetstone, Near Leicester

Two appointments have arisen in the team responsible for the design and development of compressors, blowers, fans and circulators for a wide range of applications. Current projects include

### $CO_2$ BLOWERS FOR NUCLEAR REACTORS

### HYDROGEN BLOWERS FOR ALTERNATOR COOLING

### AND LARGE COMPRESSORS

The appointments will be of particular interest to engineers who while wishing to undertake a degree of mechanical and aerodynamic design, do not wish to lose touch with research, development and test work.

The scope of the appointments will to some extent be related to the ability of the successful applicants who should have had a formal education in the range of Ph.D. to H.N.C. together with some experience of high speed rotating machinery.

Please write, giving details of qualifications and experience to Dept. C.P.S., Marconi House, 336-7, Strand, London, W.C.2., quoting reference E1896G.

E8108 A

## ENGINEER

required by

THE ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON, BERKS.

To design a wide variety of mechanical and chemical plant, including pressure vessels and equipment for the handling of toxic and radioactive materials. To prepare estimates, specifications and work in conjunction with Consultants.

Corporate Membership of a Senior Engineering Institution or equivalent qualification is required. Applicants must have had wide design experience, possess an aptitude for tackling original problems and be capable of engineering a chemical plant from flow sheet stage.

Salary : £1345–£1800.

Contributory Superannuation Scheme.

A house or substantial assistance with house purchase will become available for married officers living beyond daily travelling distance.

POSTCARDS for application forms to the Senior Recruitment Officer, A.W.R.E., Aldermaston, Berks. Please quote ref. 2456/25.

E8160 A

BCL

## A DEPUTY DEVELOPMENT ENGINEER

is required by

## BRITISH CELLOPHANE LIMITED

Applications are invited from Engineers with good Honours degrees who have completed a post-graduate apprenticeship and have had some years' industrial experience, preferably in the sphere of design of process plant, services and auxiliary equipment. The successful applicant will be responsible to the Development Engineer for the work of an extensive team engaged on the design and development of continuous process plant and services. The duties include preparation of projects and estimates, and commissioning of plant, with later investigation of performance of plant and equipment.

The position is one of responsibility and requires a man in the age group 30–40, with initiative and ideas, who is fully conversant with present-day workshop techniques and materials of construction.

Applications, including brief details of qualifications, experience and date of birth, should be addressed to :—

The Personnel Officer,
Bath Road, Bridgwater, Somerset.

E8095 A

Classified Advts. continued on page 146

SITUATIONS VACANT

**A well-known Industrial Organisation**

*wishes to recruit a*

## MECHANICAL ENGINEER

not necessarily fully qualified, who could be responsible for the installation and maintenance of small plants of a continuous process nature in customers' premises. He would be a member of a Management team. Opportunity will occur both in the field and at Head Office on specific projects. An attractive salary is offered which will not be below £1000. Write, stating full details. —BOX No. E8180, "The Engineer."

A

SITUATIONS VACANT

**JOHNSON, MATTHEY & CO., LIMITED**

## DESIGN ENGINEER

Aged 23-33, with good drawing-office background, is required for the Chief Mechanical Engineer's office in Central London. A sound practical training and knowledge of engineering services is essential.

The work entails handling projects from the drawing-board through to construction and running in for production.

Conditions of service include free lunches and an annual bonus, also a contributory pension scheme. Salary according to age, qualifications and experience.

Write, giving full details of age, qualifications, experience, &c., to the Secretary, Johnson, Matthey & Co., Limited, 78, Hatton Garden, London, E.C.1.

E8030 A

SITUATIONS VACANT

## SENIOR DRAUGHTSMEN

experienced in bulk mechanical handling or foundry work. Superannuation Scheme. Five-day week. Apply to MARCO CONVEYOR & ENGINEERING COMPANY Ltd., Lynn Road, Leytonstone, London, E.11. LEY 2254.

E8169 A

SITUATIONS VACANT

**PRESSED STEEL COMPANY LIMITED**

The Company is engaged in large-scale manufacture of Motor Car Bodies, Commercial, Domestic and Industrial Refrigeration Plant and Railway Rolling Stock and employs some 20,000 in Plants at Oxford, Swindon, Reading and Paisley. In order to meet a continuously expanding Design and Development Programme, applications are invited for appointments as :—

## FACTORY PLANNING ENGINEERS

Candidates should be well qualified technically, with considerable experience covering all aspects of Plant, Building and Machinery and in particular in the Shop loading of Plant and Machinery.

These appointments offer the opportunity for those with experience in the above-mentioned capacity to join an expanding Organisation. Conditions of employment accord with best industrial practice. Applications, with full details of education, training, experience and salaries earned, may be made to the Staff Officer, Pressed Steel Company Limited, Cowley, Oxford, where the successful applicants will be located.

E8124 A

**WEATHERLEY OILGEAR LIMITED**

## TO SERVE THE MORE ADVANCED FIELD OF HYDRAULICS

### REQUIRED: SENIOR TECHNICAL SALES ENGINEERS

to operate as district representatives for London and South—Midlands—Northern England—Scotland. Applications are invited from those already residing centrally in these areas.

Age Group : 35 to 45 years of age.

An informative period will be foreseen but qualifications should include a good practical as well as technical knowledge and experience of the modern version of Hydraulic and Processing Applications for industry at large.

Also required are four layout engineers, either experienced in Hydraulic Application or with good technical qualifications for training.

Applicants are asked to forward fullest information, including education, training and experience (present Salary Status will help) and sufficient detail to facilitate early arrangements for interview in London.

Address to : Personnel Manager, HYDRAULIC DIVISION, Weatherley Oilgear Limited, Biggleswade, Beds.

E8189 A

## RESEARCH ENGINEER

A Graduate Engineer, aged about 27-35, is required for research and full-scale trials at Pametrada on marine steam turbines, systems, boilers and controls, with general application to advanced steam conditions. Previous experience in a similar field would be an advantage, as would be any marine experience. Starting salary in the range £1,000 to £1,500 depending on age, qualifications and experience. Staff pensions scheme, excellent facilities and working conditions. Apply in confidence to the Director, Pametrada Research Station, Wallsend, Northumberland.

E8171 A

**MSL** *have been retained to advise on the appointment of a*

## PROJECT ENGINEER

for Arthur Guinness Son & Co. (Park Royal), Ltd.

The Project Engineer will be responsible to the Deputy Chief Engineer for the design and supervision of construction of new plant and machinery, for its installation and trials ; for the drawing up and negotiation of contracts for new plant and machinery.

Candidates must be A.M.I.Mech.E. or A.M.I.Chem.E. and have had similar experience preferably in the chemical or food processing industry. Experience of structural steel work, metallurgy and mechanical handling would be an advantage.

Age : 32-35. Salary from £1,200 to £1,600 according to experience. Non-contributory pension scheme.

Please send brief details in confidence, quoting reference G.2038, to H. A. P. Disney. In no circumstances will a candidate's identity be disclosed to our client unless he gives permission after a confidential interview at which he will be given full details of the appointment.

**MANAGEMENT SELECTION LIMITED**
**17, Stratton Street, London, W.1.**

E134 A

## Maintenance Engineers for Calder Hall

**The Production Group of the**

**UNITED KINGDOM ATOMIC ENERGY AUTHORITY**

have vacancies at Calder Hall Nuclear Power Station for the following maintenance engineers :

### INSTRUMENT ENGINEER

To be responsible to the Works Engineer for the instrumentation of the Calder Hall Nuclear Power Station. Applicants should be conversant with both nuclear and conventional instrumentation and have had experience in the testing and calibration of safety and fault warning systems in a large scale plant. They must be capable of formulating and carrying out additions and modifications to instrumentation circuits for experimental or operational reasons. Experience of controlling and organising a complete instrumentation section for maintenance, design and installation is essential.

### ASSISTANT INSTRUMENT ENGINEERS

To be responsible to the Instrument Engineer for :

(*a*) the maintenance and servicing of instrumentation in a nuclear power station, including nuclear, electronic and physical instruments and reactor safety circuits, or

(*b*) the maintenance and servicing of computers, data logging equipment and for the development and installation of special instrumentation for reactor experiments.

Candidates should have had considerable experience in the maintenance and servicing of electronic and physical instrumentation and for post (*b*) the servicing and operation of computers or similar devices. Training will be given to the successful candidate, if necessary.

### ASSISTANT MECHANICAL ENGINEERS

To be responsible to the Mechanical Engineer for the maintenance of either :

(*a*) Reactor equipment including Gas Circulator overhaul, survey and modifications to Heat Exchangers and ducting and the associate steam circuits, or

(*b*) For the maintenance of Turbine Hall equipment, overhead cranes, cooling water circulating system, workshops, and other general plant.

Candidates should be experienced in the maintenance of some of the following plants : Heat Exchangers ; steam boilers ; heavy rotating equipment ; steam turbines ; large water circulating pumps ; complex mechanical handling equipment.

### ASSISTANT ELECTRICAL ENGINEER

Responsible to the Electrical Engineer for the maintenance of Turbine Hall equipment and power services in general.

Candidates should be conversant with the electrical equipment in a large conventional power station and have had experience in the maintenance of large alternators, A.C. motors, transformers, switchgear and protective equipment.

*For all posts, applicants must have served a recognised engineering apprenticeship or have had comparable training: and be corporate members of a senior engineering institution or equivalent. Possession of a University degree may be an advantage. Candidates should have had experience in the control and organisation of staff.*

**Salary : Instrument Engineer within scale £1880–£2180 p.a. / Assistant Engineers (Elect., Inst. or Mech.) within scale £1370–£1825 p.a.** } **According to qualifications and experience**

**Contributory Pension. Staff Housing Scheme.**

*Send postcard for application form, quoting Ref. P.121/51 to Recruitment Officer*

**U.K.A.E.A. PRODUCTION GROUP,**

Windscale Works, Sellafield, Seascale, Cumberland. *Closing Date : 21st December, 1959.*

E8155 A

SITUATIONS VACANT

## QUALIFIED SALES ENGINEERS WANTED

in various areas to represent Machine Tool Manufacturers and Importers of special high quality equipment. Age 30 to 40. Previous experience essential. Salary according to qualifications and experience. Very good prospects for right applicants.

Apply BOX No. E2645, "The Engineer."

A

SITUATIONS VACANT

## ELECTRICAL ENGINEER

wanted by leading German manufacturer for German-English translations. Applications are invited from British-trained engineers with a good general education and sound technical training, preferably also with practical experience in the application of electric equipment. Good working knowledge of German is essential. The ability to write clearly and concisely will be expected of candidates. A five-day week is worked with generous holidays. Favourable housing conditions for permanent staff.—Apply, stating age, education, qualifications, experience and salary required, —BOX No. E8059, "The Engineer."

A

SITUATIONS VACANT

## PRESSED STEEL COMPANY LIMITED

The Company is engaged in large-scale manufacture of Motor Car Bodies, Commercial, Domestic and Industrial Refrigeration Plant and Railway Rolling Stock, and employs some 20,000 in Plants at Oxford, Swindon, Reading and Paisley. In order to meet a continuously expanding programme, applications are invited for appointments as :

## JIG AND TOOL DESIGNERS

to be located at Oxford, Swindon and Paisley.

Candidates should already be qualified Jig and Tool Designers with considerable experience in the design of press tools for Car Body Manufacture.

These appointments offer the opportunity for those well-qualified technically, with experience in the above-mentioned capacity, to join an expanding Organisation. Conditions of employment accord with best industrial practice. Applications, with full details of education, training, experience and salaries earned, may be made to the Staff Officer, Cowley, Oxford, quoting location sought.

E8080 A

SITUATIONS VACANT

## MATERIALS HANDLING ENGINEER

Required for a medium-sized company manufacturing specialised equipment for the vehicle and motor-car industries. The Materials Handling Engineer will be responsible to the Production Engineer for materials handling and factory layout.

Essential qualifications :—

(a) Experience in the preparation of materials handling schemes, including palletisation and conveyorisation in current use in the light mass-production engineering industry.
(b) Sound knowledge of modern factory layout for batch and flow production in machine, assembly and plating shops.
(c) Knowledge of machine design, planning, work study and foundry practice would be an advantage.

Candidates should have professional qualifications in production or mechanical engineering.

Age group : 30 to 45. Four-figure salary and non-contributory pension scheme. Please send full details of career in confidence quoting reference LRM/PE.2, to CLAYTON DEWANDRE COMPANY LIMITED, Titanic Works, Lincoln.

E8212 A

## SMITHS MOTOR ACCESSORY DIVISION

## ASSISTANT CHIEF INSPECTOR

We are seeking an Inspector, knowledgeable in modern Inspection Techniques, who with confidence will be able to control a strong inspection team. He should have been trained as a craftsman, have had Quality Control experience and be conversant with gauge and tool design.

Preferably, he would have been associated with the large-scale production of components, including die-castings and small pressings, also with the assembly of small mechanisms.

Ability to report lucidly both verbally and in writing is essential.

Applicants, who should be qualified to H.N.C. standard in Mechanical Engineering, will have served an apprenticeship and progressed through workshops and drawing-offices and to be at present in receipt of a four-figure salary.

The appointment will carry with it consideration for the post of Chief Inspector within the next few years.

*Applications will be treated in strict confidence and should be addressed to the Staff Manager, quoting reference SM 220,*

**S. SMITH & SONS (ENGLAND), LTD.,**
**Cricklewood, London, N.W.2.**

E8157 A

## PROJECT MANAGER

An International Company engaged in the Design, Procurement, and Construction of major Oil Refinery and Chemical plants requires a senior man to take control of multi million pound projects.

Applicants should already be in a similar position, and should hold either A.M.I.Mech.E. or A.M.I.Chem.E.

Commencing salary in the region of £3,000 per annum, with the normal benefits of a well-established Company.

*Please write, giving fullest particulars of age and experience, &c., to :* BOX No. E8077, "The Engineer."

A

## BCL

## MECHANICAL DRAUGHTSMEN

are required for the

**ENGINEERING DIVISION**

of

**BRITISH CELLOPHANE LIMITED**

The posts, which are permanent in nature, are for Senior Draughtsmen for work on machine design, plant layout and associated work in a chemical process industry. Candidates must possess at least O.N.C., have either served an apprenticeship or had several years' shop experience and been engaged in similar drawing-office work.

Applications, stating full details, giving age, and quoting Ref. E95, to be addressed to :—

The Personnel Officer,
Bath Road, Bridgwater,
Somerset.

E8170

## MECHANICAL, INSTRUMENT AND ELECTRICAL ENGINEERS

COURTAULDS requires qualified Mechanical, Instrument and Electrical Engineers, aged 25 to 40, for important work in design, construction and maintenance of large synthetic fibre and chemical plants. Preference will be given to candidates who have a good Honours Degree in Mechanical or Electrical Engineering, and, for the junior appointments, to those who have already completed a suitable apprenticeship and had two or more years' experience in the design or maintenance of industrial plant.

The vacancies are additional permanent appointments with opportunities for obtaining a wide experience in the process engineering and contracting fields and prospects of promotion for men with an original approach to problems are excellent. The work is exceptionally varied, covering the complete range of engineering activities from heavy industrial equipment to fine mechanisms and highly specialised machinery of Courtaulds' own design, and including boiler and power plant and distribution of services.

Successful candidates will be given the necessary background knowledge of the various processes concerned to enable them to further the development of modern manufacturing techniques and automatic control in the industry.

Financial assistance is normally awarded to married men when moving house. The appointments are pensionable and the occupants will be eligible for Co-partnership benefits.

Candidates should write for a detailed form of application to the Director of Personnel, Courtaulds Limited, 16, St. Martin's-le-Grand, London, E.C.1, quoting reference number B.55.

E8126 A

## CONSULTING ENGINEER FOR WEST INDIES

Well-known London Consulting Engineers are seeking a Senior Engineer for duty in the West Indies. The first appointment would be for two years, following preliminary training in London. If concluded successfully, the Engineer would be given an opportunity to establish a permanent branch of the office, leading to a Partnership and a professional career of great promise in that region.

Applicants must be fully experienced in the mechanical equipment of buildings, including air-conditioning, steam and hot water supply, electrical services and lifts. Experience in hospital engineering would be especially advantageous. Qualifications preferred are a University Degree and Associate Membership of one or more senior Institutions.

The successful applicant will be under 40, must enjoy good health and a stable character, and be possessed of a good social sense.

A good salary will be offered with travelling and housing allowances for family and up to two months' home leave every year. A non-contributory pension scheme is run by the firm.

The strictest confidence will be extended to and expected from any applicant, who should send full career details to BOX No. E8158, "The Engineer."

Interviews will be held in London and travel and subsistence expenses will be paid to those invited.

A

Following the recent announcement of the formation of a new Company in the United Kingdom to manufacture all types of electrical connectors,

## BICC-BURNDY LIMITED

wish to appoint immediately SALES ENGINEERS, who will be based on Prescot Works, to promote the sale of these products throughout the United Kingdom for Electricity Board transmission, distribution and power station work ; switchgear, appliances and electronic manufacturers and also connectors having a wide application in the aircraft, shipbuilding and missile industries.

Previous sales experience is essential, preferably with one or more of the activities mentioned. Candidates should also have a practical engineering background and a Degree or Higher National Certificate.

A commencing salary up to £1200 per annum is envisaged ; a Company car is provided and an adequate expense allowance.

Applications, quoting in detail age, qualifications and experience, should be addressed to :

Works Personnel Officer,
Ref. P.924,
British Insulated Callender's Cables, Ltd.,
PRESCOT, Lancashire.

E8193 A

**Classified Advts. continued on page 148**

## SITUATIONS WANTED

**CHARTERED MECHANICAL ENGINEER AND FUEL TECHNOLOGIST** (40) seeks Research, Design or Operational post. I.C. engines, thermal plant or fuel economy. Ex-R.E.M.E., sound general background. Present salary £1500.—BOX No. E2653, "The Engineer." B

## SUB-CONTRACTING

**CASTINGS.**—We can save your porous castings, ferrous or non-ferrous, by an approved impregnation process; sample castings treated; A.I.D. approved.—Recupero, Ltd., 66, South Harrow Viaduct, Harrow, Middlesex (Phone, Byron 1178). E109 MW

**KELLERING AND CAM PROFILING** capacity up to 8ft. by 6ft. or 6ft. diameter.—ARMYTAGE BROS. (KNOTTINGLEY), Ltd., The Foundry, Knottingley, Yorkshire (Telephone: Knottingley 2743/4). E116 MW

## AGENCIES

**DO YOU WANT TECHNICAL REPRESENTATION IN NORTH?** Young A.M.I.Mech.E. wishes to represent engineering companies interested in obtaining thorough coverage of North, on agency basis. Excellent contacts. Past five years selling British and German equipment to steel, chemical and engineering works and local authorities. Hard worker with ambition. Full information and references supplied. Strict confidence.—BOX No. E2654, "The Engineer." D

## BUSINESSES and PREMISES

**PRECISION ENGINEERING BUSINESS** for Sale. Turnover £75,000 per annum. Directors retiring.—BOX No. E172, "The Engineer." L

## BUSINESS OPPORTUNITIES

**REMPLOY SPONSORSHIP SCHEME.**—Send for details which show an attractive proposition to manufacturers.—Write to the Managing Director, Remploy, Ltd., 25–28, Buckingham Gate, S.W.1, or telephone VICtoria 6621 (12 lines). E155 G

**ENGINEERING SALES ORGANISATION** operating from prominent London address and well known as suppliers of equipment to oil, power, and process industries would be pleased to hear from firms manufacturing products applicable to these industries and who would benefit from an international set up.—BOX No. E8185, "The Engineer." O

**MANCHESTER ENGINEERING SALES ORGANISATION** operating from good city address, would be interested to handle further equipment applicable to chemical, oil, power, nuclear or any process industry.—BOX No. E8218, "The Engineer." O

## PATENTS

**THE PROPRIETOR** of British Patent No. 756700, entitled "APPARATUS FOR GENERATING A MIST OR FOG OF LUBRICATING OIL," offers same for License or otherwise, to ensure practical working in Great Britain.—Enquiries to Singer, Stern and Carlberg, 14, E. Jackson Blvd., Chicago 4, Illinois, U.S.A. E8179 H

## FOR HIRE

**LATTICE STEEL ERECTION MASTS** (light and heavy), 30ft. to 150ft. high, for immediate hire.—Bellman's, 21, Hobart House, Grosvenor Place, S.W.1. E103 K

**MOBILE LIFTING SERVICES.**—Lump sum or Hire Rate Quoted for any Lifting Work by Lorry-Mounted or Crawler Cranes, any size, any area.—TARSLAG, LTD., Rotherham 3235. E168 K

## MISCELLANEOUS

**DAVIES INVESTMENTS LIMITED,** Bankers, still offer 7½ per cent. on sums £20 to £500 (withdrawal on demand) with extra ½ per cent on each £500 unit.—Details from Investment Dept., E.R., Davies Investments, Ltd., Danes Inn House, 265, Strand, London, W.C.2. E149 I

**REQUIRED** back numbers of "The Engineer" for July 5th, July 12th and November 1st, 1957. Reasonable prices annd expenses paid.—Write in first instance to The Hunslet Engine Co., Ltd., 125, Jack Lane, Leeds, 10. E173 I

## MACHINERY Etc. WANTED

**WANTED:** Crane on own chassis or lorry-mounted. All types up to 8 tons considered.—BOX No. E7917, "The Engineer." F

**WANTED.**—Crane on own chassis or lorry-mounted. All types up to 8 ton considered.—BOX No. E8156, "The Engineer." F

**REQUIRED** for work in Scotland, 12 B. Emico, price and details to Duncan Logan & Co., Great North Road, Muir-of-Ord, Ross-shire. E8166 F

**200-TON DOUBLE SIDED, DOUBLE CRANKED PRESS.** Bed area 60in. by 36in. minimum, stroke 5in. minimum. Price and particulars.—BOX No. E8222, "The Engineer." F

**REQUIRED BORING MACHINE.**—Specification diameter of work table 60–65in. Max. dia. of work admitted 64–80in. Diameter of turret holes 3in., swivel of turret, either side 35 deg. Admits in height under turret 35in., admits in height under cross-slide 24in., vertical feed to turret 26in., horizontal feed of turret, chuck centre outwards 40in. No. of table speeds twelve, range of table speeds. Machine to be with three different speed ranges, preferably of 2·5 to 55·5 r.p.m. or 3·6 to 86 r.p.m. or 4·5 to 100 r.p.m. A. KING & SONS, Ber Street, Norwich. Tel.: Norwich 28541 (5 lines). E8217 F

## FOR SALE

### AIR MINISTRY

### PURCHASE AND REMOVAL OF BELLMAN HANGARS

TENDERS invited for PURCHASE AND REMOVAL OF BELLMAN HANGARS, approximately 175ft. by 95ft., situated at Heathfield, Prestwick, Ayrshire, and Detling, Kent. Apply Air Ministry, C.19a, Turnstile House, London, W.C.1, for form of Tender. E8172

### FRED WATKINS (ENGINEERING) LTD.

Fielding 500-ton Vertical Downstroke Hydraulic Press, 42in. by 36in. platens, with pumps and motors.

Fielding 200-ton ditto, 3ft. stroke, with pumps and motors (5 available).

Fielding 100-ton ditto, 4ft. to 5ft. stroke, with pumps and motors.

Two 73ft. 4in. by 4ft. Brick Lined Kilns or Dryers, with Crofts reduction gears and motors.

Two 26ft. by 4ft. Rotary Cooler or Dryers, with reduction gear and motor.

**FRED WATKINS (ENGINEERING), LTD., COLEFORD, GLOS.** E151 G

TWW

NEW "FICEP" STANDARD UNIVERSAL PUNCHING, SHEARING, CROPPING AND NOTCHING MACHINES, all sizes ⅝in. to 1in. M.S., &c.

NEW "FICEP" ALLIGATOR SHEARS, 1¼in., 2in., 3in. bar cap.

NEW "FICEP" 3in. bar cap BILLET SHEAR.

"SCRIVEN" D.E. PUNCH, SHEAR AND ANGLE CROPPER, 1¼in. plate, 6in. by 1in. angles.

NEW "OSMOND" 10in., 12in., 14in., 16in. ABRASIVE CUT-OFF MACHINES.

### THOS. W. WARD LTD.

ALBION WORKS - - - SHEFFIELD
'Phone: 26311. 'Grams: "Forward."
E215 G

**FOR SALE**

**RICHARDS NO. 3 TYPE PR HORIZONTAL BORING, FACING, MILLING, DRILLING AND TAPPING MACHINE** with screw cutting attachment; 3¼in. dia. traversing spindle; facing head capacity 42in.; machine fitted with Verniers to longitudinal cross and vertical feeds. Built 1945. In first class condition.

F. J. EDWARDS LTD.,
359–361, EUSTON ROAD,
LONDON, N.W.1.
EUSton 4681 and 3771.
E8159 G

### 600

**CONDENSERS AND HEAT EXCHANGERS**

BELLISS & MORCOM Surface Condenser, 8ft. 6in. long by 3ft. 6in. dia., designed for 8400 lb. exhaust steam per hr., maintaining 26in. vacuum when supplied with 29,000 galls. of cooling water per hr. at 75 deg. F. Complete with water circulating and condensate pump.

WORTHINGTON SIMPSON 7500 lb. steam per hr. at a vacuum of 26in. when supplied with 30 g.p.m. of circulating water at 80 deg. F. Complete with combined A.C. motor-driven water circulating and condensate extraction pump.

DAVEY PAXMAN Surface Condenser, 10,000 lb. steam per hr. at 26in. vacuum when supplied with 500 galls. of cooling water per min. at a temperature of 70 deg. F. Complete with water circulating and extraction pump.

BELLISS & MORCOM Condenser, 17,000 lb. steam per hr. at 25in. vacuum when supplied with 43,000 galls. of cooling water per hr. at a temperature of 80 deg. F. Complete with extraction pump and air ejector.

GEORGE COHEN,
SONS AND CO. LTD.
WOOD LANE, LONDON, W.12.
(Phone: Shepherds Bush 2070); and
STANNINGLEY, Nr. LEEDS.
(Phone: Pudsey 2241) E201 G

**DIESEL SHUNTING LOCOMOTIVE.** 0-4-0 B.H.P., suitable for 4ft. 8½in. gauge track. Flameproof construction. Manufactured by Hudswell, Clarke and Co., Ltd. Hardly used. In mint condition. Cost £15 000, accept £7,500. Stored London. Full specification upon request.—BUTLER TRADING (SOUTHSEA), LIMITED, 80, Marmion Road, Portsmouth ('Phones: 25244/5). E8229 G

**NISSEN TYPE HUTS** for sale. Prompt despatch of 16ft., 24ft., and 30ft. wide huts; also "Romney" Huts, 35ft. wide, and "Blister" Hangars, 86ft. 6in. and 91ft. wide. These buildings are in various lengths and comprise steel framework with galvanised corrugated steel sheeting.—Full details from Dept. 115, J. Thorn and Sons, Ltd., Brampton Road, Bexleyheath, Kent. (Tel.: Bexleyheath 305). E113 G

## FOR SALE

### 600

**DIESEL ENGINE DRIVEN ALTERNATOR SETS**

234kVA, 400/440 volts, 3-phase, 50 cycles, 4-wire Diesel Engine Driven Alternator Set, mounted on baseplate and direct coupled at 500 r.p.m., comprising engine by MIRRLEES BICKERTON & DAY, type UA.8, 8-cylinder type, direct coupled to alternator by METROPOLITAN-VICKERS, with direct coupled exciter, set complete with standard ancillaries and switchgear.

225kVA, 380/420 volts, 3-phase, 50 cycles, 4-wire Diesel Engine Driven Alternator Set, direct coupled at 600 r.p.m. and comprising engine by MIRRLEES BICKERTON & DAY, type TL.5, 262 h.p., temperate 12-hour rating, 5-cylinder, direct coupled to alternator by BRUSH ELECTRICAL, having direct coupled exciter and complete with switchgear.

180kVA, 400/440 volts, 3-phase, 50 cycles, 4-wire Diesel Engine Driven Alternator Set, direct coupled at 750 r.p.m. and comprising engine by MIRRLEES BICKERTON & DAY, type J.3, 210 b.h.p. 12-hour rating, direct coupled to alternator by BRUSH ELECTRICAL, complete with direct coupled exciter. Set complete with standard ancillaries and switchgear.

169kVA, 400/440 volts, 3-phase, 50 cycles, 4-wire Diesel Engine Driven Alternator Set, direct coupled at 600 r.p.m. and comprising engine by BLACKSTONE, type EPV.6, 6-cylinder 4-stroke, direct coupled to alternator by BRUSH ELECTRICAL, with direct coupled exciter, set complete with standard ancillaries and switchgear.

145kVA, 400/440 volts, 3-phase, 50 cycles, 4-wire Diesel Engine Driven Alternator Set, direct coupled at 500 r.p.m. and comprising engine by BLACKSTONE, type EPV.5, 5-cylinder 4-stroke, direct coupled to alternator by CROMPTON PARKINSON, having direct coupled exciter, set complete with standard ancillaries and switchgear.

GEORGE COHEN,
SONS AND CO. LTD.
WOOD LANE, LONDON, W.12.
(Phone: Shepherds Bush 2070); and
STANNINGLEY, Nr. LEEDS.
(Phone: Pudsey 2241.) E202 G

**HYDRAULIC PRESSES**

FOR ALL DUTIES

Our Current Stock includes the following:
5340 ton Up-Stroking PRESS, 8ft. by 5ft., with Pump Unit.
3000 ton Down-Stroke PRESS, 10ft. 6in. by 8ft.
2000 ton Multi-Daylight PRESS, platens 6ft. by 4ft.
475 ton FLANGING PRESS, table 10ft. dia.

REED BROTHERS (ENGINEERING), LTD.,
Replant Works,
Woolwich Industrial Estate,
LONDON, S.E.18.
Telephone: WOOlwich 7611/6.
E7970 G

**FOR SALE.**—Double Helical Double Reduction Oil-cooled Gear Unit and combined Mill Pinion Housing by Turbine Gears, Ltd., new 1943, to transmit 600 h.p., normal, at speed 738/38·7 r.p.m., fitted with roller bearings (unused).—F. BURRILL & CO., 235a, Cathedral Road, Cardiff. Tel.: 26100. E8032 G

**16-ROLL PLATE STRAIGHTENING MACHINE BY "HORN & BUIRE"** For Sale. Capacity approximately ⅝in. Maximum width admitted 61in. Diameter of rollers 6in. Sheet feeding and ejection device. Weight about 10 tons.—F. J. EDWARDS, LIMITED, 359, Euston Road, London, N.W.1, or 41, Water Street, Birmingham, 3. E8225 G

**BUNKER CLAMSHELL GATES**
**LEVER OR AIR OPERATED**
**ALL STEEL CONSTRUCTION**

**MAXIM CONVEYORS (ENGLAND) LTD.**
**BELVEDERE, KENT**
Ring ERITH 4223
E170 G

## FOR SALE

Edwards

BRADLEY & CRAVEN Size No. 6 Open Fronted Geared Inclinable Power Press, motorised for 400/3/50, pressure exerted approximately 60 tons, stroke 4in., bed 29½in. by 19in., with automatic safety guard and provision for detachable front tie bars. Weight approximately 75 cwt.

RHODES Double Geared Press Brake, with cast iron side frames reinforced by nickel-chrome steel bars, bed and top beam are of steel plate, pressure exerted 150 tons, former capacity 10ft by ⅛in. or 18ft. by approximately ¼in., clear width between housings 10ft. 2in. Weight approximately 20 tons.

RUSHWORTH High Duty, Double Geared, Guillotine Shearing Machine, Overcrank type, capacity 96in. by ¼in. mild steel plate, motorised for 400/3/50, fitted with automatic sheet hold-down and fluorescent lighting unit, depth of gap 4in. Weight approximately 120 cwt.

RHODES No. 22 Geared, Double Sided, Motorised Bar Shearing Machine, similar in construction to a double-sided power press, motorised for 400/3/50, shears mild steel plates up to 17in. wide by 1¼in. thick, length of blades 17in., pressure exerted approximately 250 tons, stroke 5¼in., width between guides 25¼in., strokes per minute approximately 10. Weight approximately 13½ tons.

NEW BESCO High-Speed Power Operated Plate Bending Roller, of steel plate construction, capacity 39in. by ¼in. in mild steel, motorised for 400/3/50, diameter of top roller 4¼in., bottom roller 4in. Weight approximately 19 cwt.

BESCO Heavy Universal Edging, Bending and Folding Machine, capacity 6ft. 2in. by 14 Gauge, fitted with centre supporting leg to strengthen bottom bed, complete with two blades for sharp and round bends. Weight approximately 23 cwt.

Photographs of the above are available.

Very favourable Hire Purchase terms can be obtained.

MACHINE TOOLS, NEW AND USED,
Of Every Description. Attractive Prices.

F. J. EDWARDS LTD.,
359–361, EUSTON ROAD,
LONDON, N.W.1.
Telephone: EUSton 4681–3771.
And at
LANSDOWNE HOUSE, 41, WATER STREET,
BIRMINGHAM, 3.
Telephone: Central 7606–8.
E207 G

**Most things are within reach—if you *remember* WARDS *might have it!***

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ALBION WORKS, SHEFFIELD.

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**THE GENERAL PURPOSE FASTENER FOR ENGINEERS.**

**Simple—Positive—Self Locking. Made in a variety of types and sizes. Special Fasteners to suit customers' requirements.**

**Used on aircraft, automobiles, coaches, caravans, rail coaches, electrical, radio and radar units, refrigerators, marine craft, display equipment, etc.**

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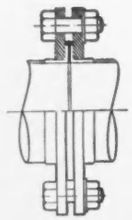

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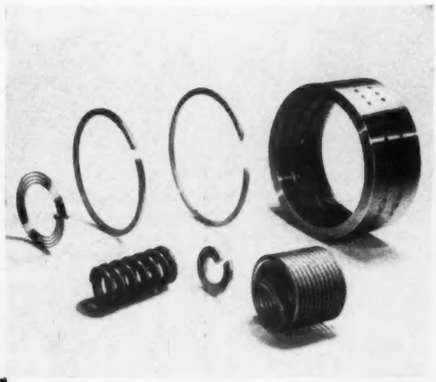

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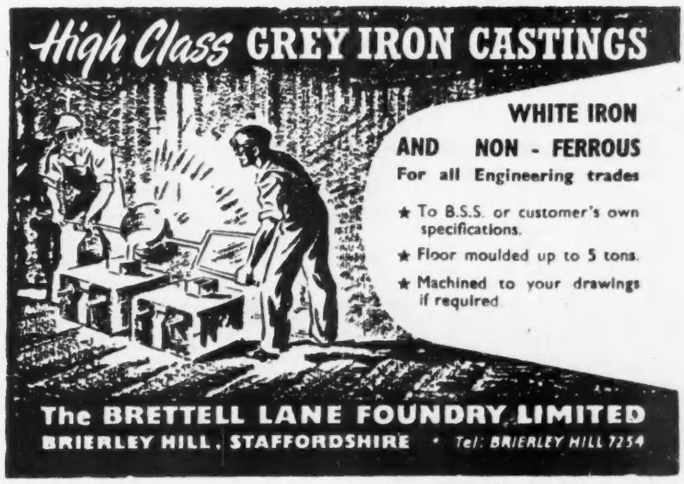
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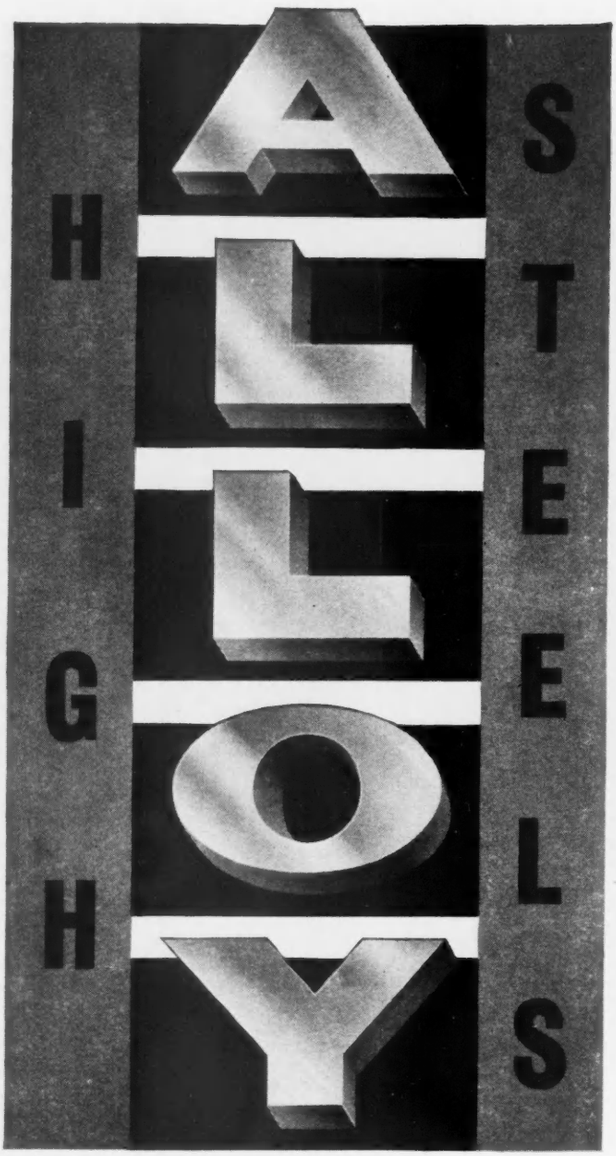


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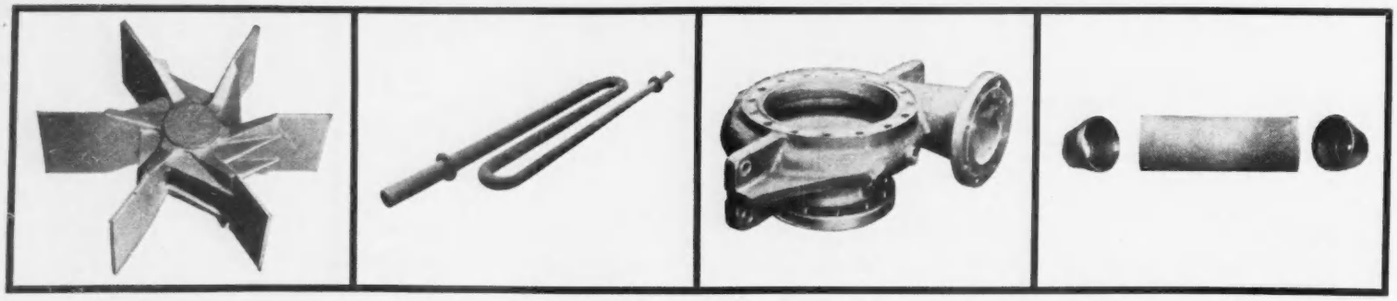

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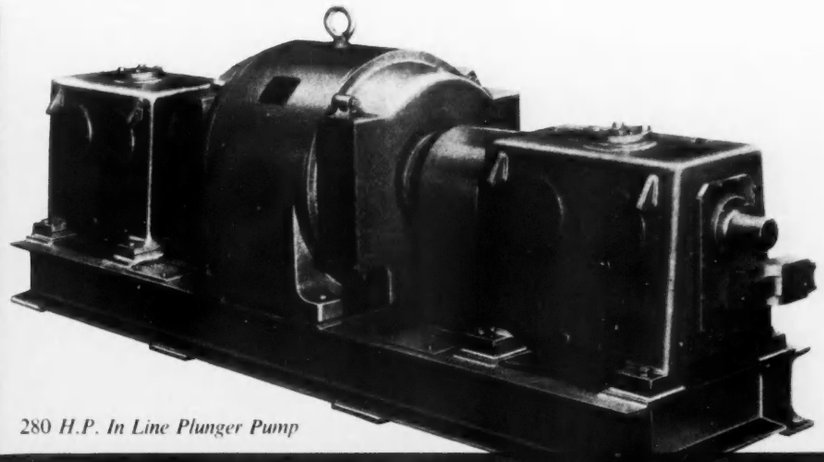
If it's Power Pumps large or small ... it's



280 *H.P. In Line Plunger Pump*

TOWLER BROTHERS

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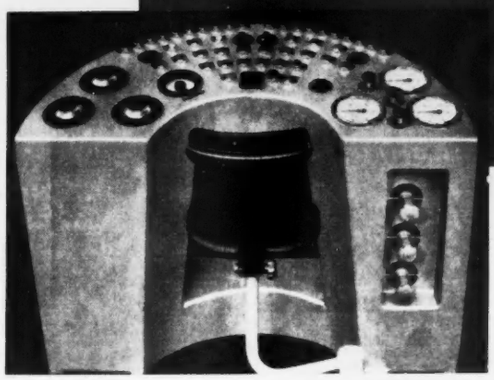
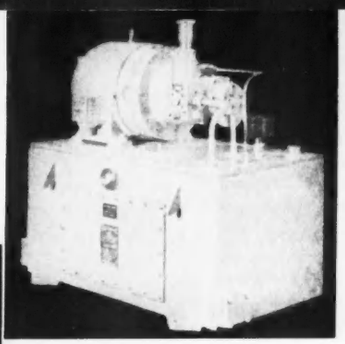


*Control desk for* 1,400-*Ton Extrusion Press*



*Packaged Unit consisting of electric motor and axial plunger pump with calibrated relief valves mounted on oil supply tank.*

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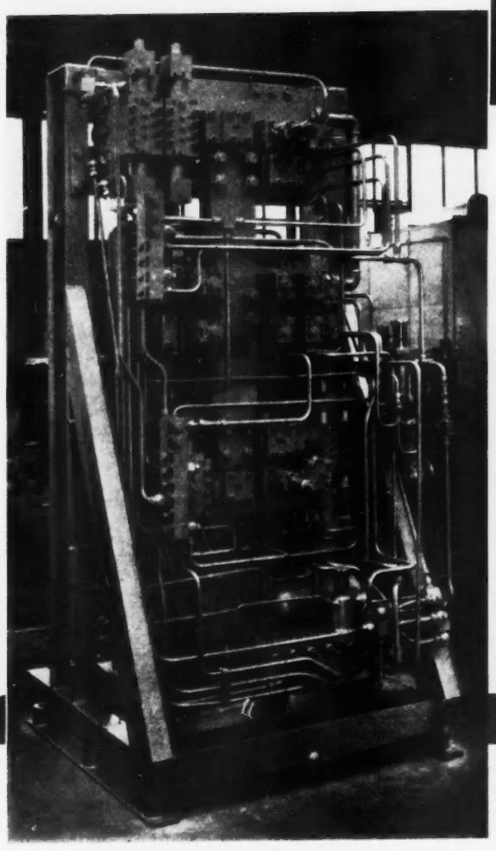
PUMPS
CONTROLS
AUTODRAULIC



*Valve Station for* 1,000 *Ton Piercing Press*

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